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Allocation of NRC Inspection Effort to Risk-Related Activities in Nuclear Power Plants

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Sandia Laboratories

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ALLOCATION OF NRC INSPECTION EFFORT TO RISK-RELATED ACTIVITIES IN NUCLEAR POWER PLANTS

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ABSTRACT

The inspection modules in the NRC inspection program for the Preoperational Test, Startup Test, and Operations phases of nuclear power plants were examined to assess whether manhours invested in each inspection were commensurate with the potential of these inspections for detecting conditions which would contribute significantly to risk. No basis was found in this assessment for fundamental changes to the inspection program. However, to improve program effectiveness, some modifications to specific parts of the program appear to be warranted.

SUMMARY

This report describes an investigation of the inspection program applied to the Preoperational Test, Startup Test, and Operations phases of light water reactor power plants by the U.S. Nuclear Regulatory Commission (NRC). The purpose of the investigation was to assess the extent to which resource investments in individual inspections (or groups of related inspections) were commensurate with the potential of these inspections for detecting conditions that would contribute significantly to risk. The basis for this assessment was the analysis of data on inspection manpower investments provided by the NRC Office of Inspection and Enforcement (IE), coupled with judgments regarding the effectiveness of the inspections in addressing important safety-related plant conditions.

The primary objective of the IE inspection program is to ascertain whether the owners and operators of the power plants (licensees) have established administrative programs that address all risk-related activities and have complied with regulatory requirements and commitments. To achieve this objective, the inspection program is designed to determine (1) whether licensee administrative programs have been adequately defined, and (2) whether these programs are implemented.

A secondary objective of the inspection program is to supplement the licensees' efforts to assure public safety by making independent observations regarding the safety status of nuclear plants. However, this secondary objective is sharply constrained by both law and limitations of NRC resources. Accordingly, the judgments made regarding IE inspections were based largely on the extent to which they served the primary objective of the inspection program.

The following steps were taken to evalulate the allocation of IE inspection effort to risk-related conditions of light water reactor power plants:

1. Plant features and activities important to public safety were identified and grouped into inspection program areas.

2. Each inspection module was reviewed to evaluate its effectiveness in meeting its stated objective.

3. Each module was associated with the program areas to which it applied.

4. The average manhours required to complete each inspection module were estimated.

5. The manhours invested in each program area (inspection category, subcategory, and regulatory element) were analyzed.

6. The noncompliance detection rate of inspection modules was compared.

Because of the nature of the available data, the risk-related plant features and activities could not be ranked according to their importance to safety, nor could a precise determination be made of the manpower invested in individual inspections. Nevertheless, the assessment identified potential improvements, primarily for the regional inspection program, in both specific inspections and inspection program areas.

Although no basis was found in the assessment for fundamental changes to the inspection program, adjustments to some program areas could be made to improve overall effectiveness. It was concluded that an increase in the level of inspection effort was warranted for the Operations phase. An increase in the manhours applied to independent inspection and followup inspections was also judged to be appropriate. A list of specific changes to inspection modules which would contribute to these adjustments is provided in the report. Other changes to improve inspection coverage and to provide better information for inspection program management are also described.

CONTENTS

		Page
1.	Introduction	11
	1.1 General	11
	1.2 Background	11
	1.3 Limitations	12
	1.4 Definition of Terms	13
2.	Summary of Analysis	17
	2.1 General	17
	2.2 Inspection Program Areas	17
	2.3 Review of Inspection Modules	19
	2.4 Association of Modules With Inspection Categories and/or Inspection Elements	21
	2.5 Analysis of Manhours Invested in Inspections	22
	2.6 Analysis of Manhours Invested in Program Areas	23
	2.7 Analysis of Noncompliance Detection Rate	24
3.	Findings and Conclusions	33
	3.1 General	33
	3.2 Inspection Modules	33
	3.3 Inspection Module Distribution	34
	3.4 Overall Program Assessment	34
	3.5 Other Conclusions	38
APPENDIX A -- Inspection Program Areas		41
APPENDIX B -- Review of Individual Modules		53
APPENDIX C -- Association of Inspections with Program Areas		59
APPENDIX D -- Calculation of Manhours Invested in Inspection Modules		73
APPENDIX E -- Analysis of Manhour Investment		95
APPENDIX F -- Analysis of Noncompliance Data		119
References		133

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TABLES

Table		Page
2-1	Manhours by Inspection Category - Regional	25
2-2	Percent of Manhours by Inspection Category - Regional	26
2-3	Regional Inspection Program Manhours/PWR	27
2-4	Regional Inspection Program Manhours/BWR	27
2-5	Manhours per Noncompliance by Inspection Category - Regional	30
2-6	Manhours per Noncompliance by Inspection Phase - Regional	31
3-1	Potential Increases in Regional Inspection Program	35
3-2	Potential Decreases in Regional Inspection Program	39
A-1	Summary of Mitigating Functions	44
A-2	Summary of Initiating Events	48
A-3	10CFR50 Appendix B	52
A-4	Other Routine Inspections	52
C-1	Modules for Mitigating Functions PWR-LOCA	63
C-2	Modules for Mitigating Functions PWR-Transient	64
C-3	Modules for Mitigating Functions BWR-LOCA	65
C-4	Modules for Mitigating Functions BWR-Transient	66
C-5	Modules for Initiating Events PWR	67
C-6	Modules for Initiating Events BWR	68
C-7	Modules for Quality Assurance - 10CFR50 Appendix B	69
C-8	Modules for Other Routine Inspections	70
C-9	Modules for Nonroutine, Independent, and Administrative Inspections	71
D-1	Calculated Manhours Preoperational - Regional	84
D-2	Calculated Manhours Startup - Regional	87
D-3	Calculated Manhours Operations - Regional	89
D-4	Calculated Manhours Preoperational - Resident	91
D-5	Calculated Manhours Startup - Resident	92
D-6	Calculated Manhours Operations - Resident	93
E-1	Manhours by Mitigating Function - Regional	97
E-2	Manhours by Initiating Event - Regional	99
E-3	Manhours for 10CFR50 Appendix B - Regional	101
E-4	Manhours for Other Routine Inspections - Regional	103

TABLES (cont)

Table		Page
E-5	Manhours for Nonroutine, Independent and Administrative Inspections - Regional	104
E-6	Manhours by Inspection Category - Regional	105
E-7	Percent of Manhours by Inspection Category - Regional	106
E-8	Regional Inspection Program Manhours/PWR	107
E-9	Regional Inspection Program Manhours/BWR	107
E-10	Manhours by Mitigating Function - Resident	108
E-11	Manhours by Initiating Event - Resident	110
E-12	Manhours for 10CFR50 Appendix B - Resident	112
E-13	Manhours for Other Routine Inspections - Resident	114
E-14	Manhours for Nonroutine, Independent and Administrative Inspections - Resident	115
E-15	Manhours by Inspection Category - Resident	116
E-16	Percent of Manhours by Inspection Category - Resident	117
F-1	Manhours per Noncompliance, Preoperational - Regional	122
F-2	Manhours per Noncompliance, Startup - Regional	125
F-3	Manhours per Noncompliance, Operations - Regional	127
F-4	Manhours per Noncompliance, Preoperational - Resident	129
F-5	Manhours per Noncompliance, Startup - Resident	129
F-6	Manhours per Noncompliance, Startup - Resident	130
F-7	Manhours per Noncompliance by Inspection Category - Regional	131
F-8	Manhours per Noncompliance by Inspection Phase - Regional	132

ALLOCATION OF NRC INSPECTION EFFORT TO RISK-RELATED ACTIVITIES IN NUCLEAR POWER PLANTS

1. Introduction

1.1 General

This report describes Task 1 of a study* conducted for the U.S. Nuclear Regulatory Commission (NRC) to analyze the nuclear power plant inspection program from the standpoint of risk and human reliability. Task 1 assesses the extent to which resource investments in individual inspections were commensurate with their potential for detecting conditions which would contribute significantly to risk. This assessment was based on the analysis of data on inspection manpower investments provided by the NRC Office of Inspection and Enforcement (IE), and on judgments regarding the effectiveness of the inspections in addressing important safety-related plant characteristics.

Task 2 of this study examines the maintenance, test, and calibration procedures used at nuclear power plants by licensees to identify procedural characteristics which contributed to human error. Based on this identification, a set of inspection methods was developed for IE to evaluate licensee procedures. Task 2 activities and results are described in a separate report.[1]

1.2 Background

The basic responsibility for public health and safety at nuclear power plants is legally assigned to the owners and operators (licensees) of the facilities. NRC's function is to make sure that licensees meet

*The study was entitled "Application of Risk and Human Reliability Analysis to IE Inspection Program."

their responsibilities. To provide this assurance, NRC has established a body of regulatory requirements, binding on licensees and their contractors. Licensee commitments are also required on facility design, construction, and test and operating processes to make sure that they adhere to public health and safety standards.

The primary objective of the IE inspection program is to ascertain whether licensees have administrative programs that address all risk-related activities and that comply with regulatory requirements and commitments. To meet this objective, the inspection program is designed to determine (1) whether licensee administrative programs have been adequately defined, and (2) whether these programs are implemented.

A secondary objective of the IE inspection program is to determine the safety status of the nuclear plants through independent observations. However, since the implementation of this secondary objective is sharply constrained by both law and limitations of NRC resources, the judgments made regarding the inspection program are based on the extent to which they served the primary objective.

1.3 Limitations

The IE inspection program consists of inspections performed during all phases of nuclear power plant activity--from design to decommissioning. The assessments made in this study were limited to those procedures which were applied during the Preoperational Test, Startup Test, and Operations phases. Therefore, the conclusions we present here should be evaluated in relation to the overall program.

The IE inspection procedures studied were those in effect on January 1, 1979. We found that subsequent changes in inspection procedures after this date did not significantly alter our assessments and conclusions.

The inspection program for the Preoperational Test, Startup Test, and Operations phases has two major components: (1) inspections performed by inspectors based at regional IE offices, and (2) inspections performed by

resident IE inspectors based at the power plants. Separate inspection procedures (called inspection modules) are provided for each of these program components.[2] However, since the resident inspection effort is relatively recent (1978) and has yet to be implemented at all the facilities, the available data on this portion of the program are insufficient to support significant conclusions. Thus, the data and conclusions in this report are primarily pertinent to the regional inspection program.

This study does not address modules which pertain to safeguards, i.e., plant protection and nuclear materials inventory. Thus, the overall manhour investment data shown for the reactor inspection program is exclusive of time devoted to safeguards inspections.

1.4 Definition of Terms

Program Definition. The licensee's delineation of an administrative program for specific activities, e.g., preoperational test of a plant system or surveillance of the Operations phase. Program definition is usually inspected by examining administrative documents and supporting procedures.

Program Implementation. The licensee activities that carry out a defined program. Program implementation is inspected by witnessing licensee activities and by reviewing facility records and/or observation of plant status.

Inspection Program Area. Any portion of the inspection program which is of interest with respect to inspection resource investment and potential impact on safety. Examples of program areas are the Preoperational Test inspection program, Nonroutine Inspections, and Post Accident Heat Removal System inspections.

Inspection Category. Those program areas designated Administrative Inspection, Independent Inspection, Routine Inspection, and Nonroutine Inspection.

Administrative Inspection Activities. Modules in the inspection program that deal with activities other than direct inspection. Included in this category are entrance and exit interviews, management meetings, and review of topical reports.

Independent Inspection. Inspections performed outside the defined inspection program. The defined inspection program requires 80% of the total inspection effort, with 20% available for independent inspections. Independent inspections include walkthrough inspections of specific areas of the facility, exploring potential problems, and exploring areas of the inspector's specific interest or concern.

Nonroutine Inspections. Inspection activities that are contingent upon events such as the discovery of noncompliance or safety problems by either an inspector or a licensee. Nonroutine inspections generally define the nature and extent of the problem in question, and make sure that appropriate actions are taken.

Routine Inspections. Inspection activities that are either keyed to specific milestones in plant construction, testing, and operation, or scheduled to occur at a fixed frequency or period. Routine inspections include the subcategories Mitigating Functions, Initiating Events, Quality Assurance (10CFR50, Appendix B), and other Regulatory Requirements. Examples include inspections that are required for the preoperational testing of a dc power system and those that periodically check the Operations-phase surveillance program.

Mitigating Functions. Those functions which, given an initiating event such as a loss of coolant accident or reactivity transient, prevent unacceptable core damage or a large release of radioactive material to the environment. A list of mitigating functions and the plant systems which contribute to those functions is shown in Table A-1.

Initiating Events. Those events which, in the absence of appropriate mitigating functions, could lead to unacceptable core damage or a large release of radioactive material to the environment. The list of initiating events and potential causes are shown in Table A-2.

Inspection Elements. The specific program areas which make up the inspection subcategories of Routine Inspection. For example, "Reactor Trip" is an inspection element of the subcategory, Mitigating Functions.

2. Summary of Analysis

2.1 General

The following steps were taken to evaluate the allocation of IE inspection effort to risk-related conditions of light water reactor power plants:

a. Plant features and activities important to public safety were identified and grouped into inspection program areas.

b. Each inspection module was reviewed to evaluate its effectiveness in meeting its stated objective.

c. Each module was associated with the program areas to which it applied.

d. The average manhours required to complete each inspection module were estimated.

e. The manhours invested in each program area (inspection category, subcategory, and regulatory element) were analyzed.

f. The noncompliance detection rate of inspection modules was compared.

A summary of these activities and their results follows.

2.2 Inspection Program Areas

The inspection program was divided into the following program areas to examine its scope and character:

- Reactor Phases. The largest program areas. Includes Preoperational Test, Startup Test, and Operations phases.
- Inspection Categories. Subdivision of the Reactor Phases. Includes Routine, Nonroutine, Independent, and Administrative Inspections.

- Inspection Subcategories. Subdivision of the Routine Inspection category only. These include Initiating Events, Mitigating Functions, Quality Assurance, and Other Regulatory Requirements.
- Inspection Elements. The smallest program areas. They represent components of the Inspection Subcategories and are listed in Tables A-1 through A-4 of Appendix A.

The relationship between the various program areas is illustrated in Figure 2-1. For definitions of the Inspection Categories and Subcategories, see Section 1.4.

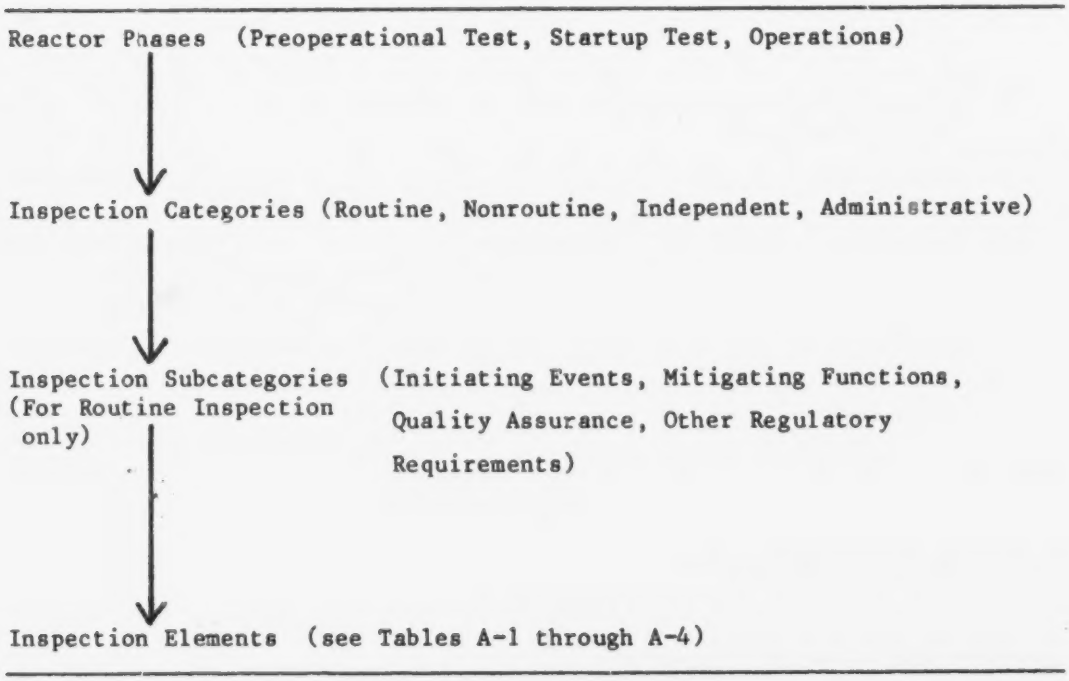

Reactor Phases (Preoperational Test, Startup Test, Operations)
Inspection Categories (Routine, Nonroutine, Independent, Administrative)
Inspection Subcategories (For Routine Inspection only)
(Initiating Events, Mitigating Functions, Quality Assurance, Other Regulatory Requirements)
Inspection Elements (see Tables A-1 through A-4)

Figure 2-1. Inspection Program Areas

The plant characteristics and activities important to public safety were identified and categorized as described above. However, because of insufficient information (particularly, information on the probability of occurrence of initiating events and mitigating functions), we were unable to rank the program areas and the items within the program areas by their

importance to safety. Consequently, these areas were assumed to have equal importance with respect to public safety.

2.3 Review of Inspection Modules

Approximately 350 modules in the Preoperational Test, Startup Test, and Operations phases were reviewed to assess the adequacy of inspection activities. We examined inspection modules for the regional inspection program (taken from IE Manual Chapters 2513, 2514, and 2515), and for the resident inspection program (taken from IE Manual Chapters 2593, 2594, and 2595). The review of the inspection modules is described in Appendix B, and the results are recorded on an "Evaluation of Inspection Module" form (Figure B-1). In general, this review indicated that the format of the inspection modules is appropriate and the module objectives were satisfactorily verified by their inspection requirements. However, there are some areas where improvements could be made:

2.3.1 Inspection Frequency

Some inspection modules in the Operations phase are scheduled for application every 3 years. These modules (which include 38701B, 38702B, and 42703B) are intended to examine the adequacy of program implementation, such as carrying out routine periodic activities. There is a significant potential for change in the implementation of licensee programs during operations, as a result of changes in personnel, organizations, or responsibility assignments. Consequently, program implementation should be inspected as frequently as practicable.

2.3.2 Inspection Definition

In the Preoperational Test and Startup Test phases the inspection modules are generally keyed to tests of specific plant systems. However, in the Operations phase, the modules are drafted according to functional activities such as calibration or maintenance. As a result, many safety-related categories are included in each module, making it difficult to (1) verify that systems important to safety have an adequate probability of being inspected; (2) verify that all of the important systems are

inspected periodically over the lifetime of a plant; and (3) document the total investment of inspection time on a system-by-system basis.

A related condition exists with respect to modules for the Startup Test phase. Here, the more significant startup tests are divided into two groups (A and B). Each inspection module pertaining to these groups describes two inspections, only one of which is to be conducted by the inspector (depending upon the group selected for the specific plant being inspected). The rules for selection of the appropriate inspection from the modules are clearly stated in the IE Manual. However, the reporting and data collection systems are based on identification of inspections by module number. Consequently, it is difficult to determine, subsequent to a Startup Test phase, which inspections were actually completed.

2.3.3 Sampling

Many parts of the inspection program entail sampling of procedures, activities, or data. Currently, samples are selected on the basis of inspector interest or concern, or for convenience of inspection. Although this method of sampling may be effective for supplementing licensee activities in assuring safety, it could also limit the opportunity for inspection of some safety-related areas. One example of this situation is found in Module 70303B which provides for sampling from a population of procedures for preoperational tests of important systems and components (the Index of Primal Tests). The number of inspections reported for each of the inspection modules appearing in this population was reviewed. During the 3-year period covered by the study for regional inspections (1976 through 1978), 30 inspections were reported for Module 70360B, Manual Reactor Control System, and none were reported for Module 70361B, Traversing Incore Probe System. While the data are not conclusive, it appears that the amount of inspection pertinent to preoperational testing of the probe system is lower than desired.

2.3.4 Guidance

The guidance portion of the modules is considered an appropriate place to provide inspectors with helpful information such as the basis for

inspection, inspection procedures, and applicable regulatory requirements. In many of the modules reviewed, the guidance was judged to be insufficent in these areas.

A number of inspection modules contain phrases, such as "No specific guidance furnished at this time," "Guidance being developed," and "More written guidance is being developed." Some of these modules are over 3 years old, and still retain the same status relative to guidance (see modules 84332B, 84711B, 72531B, 72532B, 72540B, 72548B, 72554B, 72564B, 72566B, and 80710B).

2.4 Association of Modules With Inspection Categories and/or Inspection Elements

Each inspection module in the Preoperational Test, Startup Test, and Operations phases for both the regional and the resident inspection programs was reviewed to determine the association between inspection requirements and program areas. Appendix C gives the results of that review.

As evident in Tables C-1 through C-9, there appears to be satisfactory inspection coverage for nearly all of the program areas. However, a few areas in the resultant tables do show a relatively low level of inspection coverage in the Preoperational Test and Startup Test phases:

- In Table C-1 under Post Accident Heat Removal, no inspection module was found that specifically covered the inspection of the Ice Condenser System.
- In Table C-2 under Heat Transfer to Environment, no inspection module was found that specifically covered the inspection of the Secondary Steam Relief Valve.
- In Table C-3 under Emergency Core Cooling Injection and under Containment Integrity, no inspection modules were found that specifically covered the inspection of the Manual Relief Valve or the Reactor Building-Ventilation System Isolation Valve, respectively.

- In Table C-7 under Inspection, Test and Operating Status, no inspection module was found that covered this 10CFR50 Appendix B requirement.

2.5 Analysis of Average Manhours Invested in Inspections

In order to assess the extent to which the IE program manhour investment in inspections is commensurate with the effectiveness of the inspections in addressing safety-related program areas, the manhours invested in each completion of an inspection module were analyzed. Manhour investments were identified for each module, in the phase or phases (Preoperational Test, Startup Test, and Operations) in which they were used.

Data provided by the IE Office included total manhours charged to each module and a count of the number of inspections reported for each module (Appendix D). It is important to note, however, that more than one inspection was often required to complete a module (Appendix D). Therefore, dividing the total manhours charged to a module by the number of inspections reported would generally not be a reasonable calculation of the average manhours required for module completion. For this reason, other calculations were required to determine the manhour investments. In most cases, these calculations involved assumptions regarding the average length of test phases and the application of modules during these phases. In other cases, estimates of module completion time were involved.

For regional inspection modules pertinent to the Preoperational Test or Startup Test phase, the average manhours expended per reactor per phase were calculated. For regional inspection modules applied during the Operations phase, the average manhours per reactor per year were calculated. Similar calculations were made for resident inspection modules. However, because the resident program is oriented to sites rather than reactors, the calculations were made on a "per site" rather than a "per reactor" basis.

Because of the assumptions required to calculate average manhour investments in inspection modules, substantial uncertainties exist regarding

individual module results. Consequently, the values shown in Tables D-1 through D-6 can be regarded only as estimates. Analysis of the IE data was also affected by the large variability in the time required to conduct various inspections. Administrative programs, supporting procedures, licensee activities, and records vary widely in scope and complexity from one Inspection Element to another, with a substantial effect on the time needed for satisfactory inspection. In addition, we encountered a problem in the variable number of modules needed to describe a program inspection. In some cases, the total inspection of a program area is encompassed in a single inspection module; in others, it is distributed among several modules. Because of these problems, no significant result was obtained directly from the analysis of module manpower investments.

2.6 Analysis of Manhours Invested in Program Areas

Many inspection modules address more than one of the program areas analyzed in this study. In these cases, it was necessary to allocate the estimated manhour investments in each module to the applicable program areas. Thus, we assumed that manhours applied equally to each of the program areas addressed. For example, if the investment in a module was estimated to be 12 hr and the module addressed 3 program areas, then 4 hr of inspection effort were allocated to each program area. Where an inspection module applied to only one program area, the entire manhour estimate for the module was, naturally, allocated to that area.

Manhour investments for each program area were derived by adding the allocated manhour figures for each inspection module applicable to the program area. Additional description of the analysis is contained in Appendix E and the results are shown in Tables E-1 through E-16.

The analysis of manhours invested in Inspection Elements is affected by the same problems that applied to the analysis of manhours invested in individual modules (Section 2.5). The impact of these problems diminishes as larger program areas are addressed, because uncertainties resulting from assumptions made for individual elements tend to balance out, and

because manhour investments for individual modules do not have to be allocated across Inspection Categories or Program Phases.

The manhour data for Inspection Categories are shown in Tables 2-1 through 2-4. These data indicate (with one exception) that inspection manhours are well distributed over the program areas. The exception appears to be a low level of emphasis on mitigating functions and initiating events in the Operations Phase. This is because the Operations Phase inspections focus strongly, and appropriately, on generic licensee activities associated with operating plants. These inspections address activities such as surveillance and maintenance which are designed to assure proper function of safety-related plant systems. Because the statistical data available for the study did not permit identification of the specific mitigating functions and initiating events covered by the inspections, the manpower invested was attributed to the Other Routine Inspections category.

The highest level of inspection manhours for the phases studied occurs in the Preoperational Test Phase (100 manhours per month) and the lowest in the Operations Phase (69 manhours per month).

2.7 Analysis of Noncompliance Detection Rate

One measure of the effectiveness of inspections is the number and seriousness of the problems which the inspections reveal. If an inspection detects few problems (compared to the number found by similar inspections), it may be inferred that (1) the inspection is not capable of detecting existing problems, and/or (2) the subject of the inspection is relatively free of problems. On this basis, we would recommend revising the inspection process or reducing the level of inspection effort. If an inspection is found to detect a large number of problems, it is reasonable to conclude that the level of inspection effort should be sustained or increased. In addition, the underlying causes of the problems should be identified. In the case of the reactor inspection program, this might entail increased examination of the licensee's administrative program.

Table 2-1

Manhours by Inspection Category - Regional

	Manhours Per PreOP		Manhours Per Startup		Manhours Per Year Operation	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
B W R						
Mitigating Systems	91	142	26	87		4
Initiating Events	230	104	41	105	15	32
10CFR50 APP B	94	89	68	53	37	43
Other Routine Inspection	141	232	20	62	86	260
Nonroutine Inspection	1	253		66	18	153
Independent Inspection	148	148	45	45	65	65
Admin. Activities	121		32		51	
SUB TOTALS	826	968	232	418	272	557
T O T A L S	1794 Manhours/PreOP		650 Manhours/Startup		829 Manhours/Yr. of OP	
	100 Manhours/Month		72 Manhours/Month		69 Manhours/Month	
P W R						
Mitigating Systems	124	159	21	30		3
Initiating Events	169	129	77	114	15	36
10CFR50 APP B	94	89	68	53	37	43
Other Routine Inspection	141	232	20	62	86	260
Nonroutine Inspection	1	253		66	18	153
Independent Inspection	148	148	45	45	65	65
Admin. Activities	121		32		51	
SUB TOTALS	798	1010	263	370	272	560
T O T A L S	1808 Manhours/PreOP		633 Manhours/Startup		832 Manhours/Yr. of OP	
	100 Manhours/Month		70 Manhours/Month		69 Manhours/Month	

Table 2-2

Percent of Manhours by Inspection Category - Regional

	Manhours Per PreOP		Manhours Per Startup		Manhours Per Year Operation	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
B W R						
Mitigating Systems	5.1	7.9	4.0	13.4		0.5
Initiating Events	12.8	5.8	6.3	16.1	1.8	3.9
10CFR50 APP B	5.2	5.0	10.5	8.2	4.5	5.2
Other Routine Inspection	7.9	12.9	3.1	9.5	10.4	31.3
Nonroutine Inspection	0.1	14.0		10.2	2.2	18.4
Independent Inspection	8.3	8.3	6.9	6.9	7.8	7.8
Admin. Activities	6.7		4.9		6.2	
TOTALS	46.1	53.9	35.7	64.3	32.9	67.1
P W R						
Mitigating Systems	6.9	8.8	3.3	4.7		0.4
Initiating Events	9.3	7.1	12.2	18.0	1.8	4.3
10CFR50 APP B	5.2	4.9	10.7	8.4	4.4	5.2
Other Routine Inspection	7.8	12.8	3.2	9.8	10.3	31.3
Nonroutine Inspection	0.1	14.0		10.4	2.2	18.4
Independent Inspection	8.2	8.2	7.1	7.1	7.8	7.8
Admin. Activities	6.7		5.1		6.1	
TOTALS	44.2	55.8	41.6	58.4	32.6	67.4

Table 2-3

Regional Inspection Program Manhours/PWR

INSPECTION CATEGORY	TEST PHASES MANHOURS	OPERATIONS PHASE MANHOURS/YEAR
Routine		
Mitigating	334 (14)*	3 (0)
Initiating	489 (20)	51 (6)
Appendix B	304 (12)	80 (10)
Other	455 (19)	346 (41)
Nonroutine	320 (13)	171 (21)
Independent	386 (16)	130 (16)
Administrative	153 (6)	51 (6)
Total Program	2441 (100)	832 (100)

*Figures in parentheses represent percent of total inspection hours.

Table 2-4

Regional Inspection Program Manhours/BWR

INSPECTION CATEGORY	TEST PHASES MANHOURS	OPERATIONS PHASE MANHOURS/YEAR
Routine		
Mitigating	346 (14)	4 (0)
Initiating	480 (20)	47 (6)
Appendix B	304 (12)	80 (10)
Other	455 (19)	346 (41)
Nonroutine	320 (13)	171 (21)
Independent	386 (16)	130 (16)
Administrative	153 (6)	51 (6)
Total Program	2444 (100)	829 (100)

To address the noncompliance detection rate of inspections, we reviewed the available data for the inspection modules. For each module, the total manhours charged during the period studied were divided by the number of noncompliances detected. The results of these calculations provide an indication of the average number of manhours invested per noncompliance detected. Appendix F provides a description of the analysis and Tables F-1 through F-8 present detailed results. Summary information is presented in Tables 2-5 and 2-6.

Several observations can be made regarding the results of the analysis:

a. The average manhours per noncompliance for the Operations phase is about half of that for the Startup Test phase and nearly eight times lower than the Preoperational Test phase.

b. No violations were reported during the period studied as a result of Preoperational Test or Startup Test phase inspections; seventeen were reported as a result of Operations phase inspections.

c. Average manhours per noncompliance are very high in the administrative category. This is to be expected since the effort in this area is directed primarily toward necessary activities other than inspection, such as entrance and exit interviews.

d. For the period studied, no specific inspection category (other than administrative) had a consistently high or low rate for all three phases. However, there were significant differences in these rates in the Startup Test and Operations phases.

e. The ratio of infractions to deficiencies is essentially constant across the phases, but differs by inspection category. In the Nonroutine and Independent inspection categories, 75% of the noncompliances detected were infractions while 23% were deficiencies. In the

remaining inspection categories, the average was 62% infractions, 38% deficiencies.

f. An analysis of the resident inspection program similar to that presented in Tables 2-5 and 2-6 is not presented because the available experience data were not sufficient to provide adequate confidence in the average manhours per noncompliance rates for individual inspection categories. It is worthy of note, however, that the overall rate for resident inspection modules, based on 3458 inspection hours and 21 noncompliances, is 165 manhours per noncompliance. This is nearly three times as high as the overall rate for regional inspection modules.

g. With few exceptions, the review of those modules with exceptionally high or low detection rates produced negative results. That is, the nature and extent of the inspection activities required by these modules was not found to be significantly different from other modules.

Although detection rates are often a useful measure of inspection effectiveness, a special caution must be observed with regard to the reactor inspection program. Noncompliance detection rates must be used carefully in evaluating inspections because, as we have indicated, problems detected in the program frequently do not represent failure to comply with regulatory requirements. Enforcement action in these cases therefore involves factors other than noncompliance as the cause of the problems.

Table 2-5

Manhours per Noncompliance by Inspection Category - Regional

PREOPERATIONAL

INSPECTION CATEGORIES	NONCOMPLIANCE Violations	Infractions	Deficiencies	Total	TOTAL MANHOURS	MANHOURS/ NONCOMPLIANCE
Mitigating Systems & Initiating Events	0	11	7	18	5753	320
10CFR50 Appendix B	0	4	2	6	2657	443
Other Routine	0	8	4	12	5711	476
Non Routine	0	11	6	17	3868	228
Independent	0	7	4	11	4477	407
Administrative	0	1	0	1	1831	1831
TOTAL	0	42	23	65	24,297	374

STARTUP

Mitigating Systems & Initiating Events	0	13	9	22	3725	124
10CFR50 Appendix B	0	13	11	24	1375	57
Other Routine	0	20	11	31	1164	38
Non Routine	0	7	1	8	1045	131
Independent	0	17	4	21	1378	66
Administrative	0	0	0	0	500	∞
TOTAL	0	70	36	106	9187	87

OPERATIONS

Mitigating Systems & Initiating Events	0	41	29	70	5093	73
10CFR50 Appendix B	0	55	33	88	5317	60
Other Routine	0	1019	607	1626	60,122	37
Non Routine	15	415	138	568	31,637	56
Independent	2	389	108	499	24,406	49
Administrative	0	1	0	1	9539	9539
TOTAL	17	1920	915	2852	136,114	48

Table 2-6

Manhours per Noncompliance by Inspection Category - Regional

SUMMARY

INSPECTION PHASE	NONCOMPLIANCE				TOTAL MANHOURS	MANHOURS/ NONCOMPLIANCE
	Violations	Infractions	Deficiencies	Total		
Preoperational	0	42	23	65	24,297	374
Startup	0	70	36	106	9,187	87
Operations	17	1920	915	2852	136,114	48
TOTAL	17	2032	974	3023	169,598	56

3. Conclusions

3.1 General

Based on the analyses described in Section 2, we found that the resource investments in the regional inspection program for the phases studied were generally appropriate in terms of the overall program objectives. Our assessment indicates no basis for fundamental changes to the program. However, adjustments could be made which would improve overall effectiveness. These potential inspection program adjustments are discussed below.

3.2 Inspection Modules

The review of inspection modules (Section 2.3) led to the conclusion that the basic format of the modules was satisfactory. However, based on the results of the review, the following improvements in module content were considered desirable:

a. The inclusion and updating of guidance procedures to modules (Section 2.3.4), and the expansion of guidance in many modules to include inspection bases and methods, potential pitfalls, and criteria for evaluating adequacy of findings.

b. An increase in module inspection frequency, where currently Operations phase programs are inspected only once every 3 years (Section 2.3.1).

c. The restructuring of modules for Operations phase inspections so that they are organized on a system basis rather than by functional activities, such as surveillance or maintenance. With this restructuring, a set of modules would be keyed to specific systems for each of the functional areas, resulting in improved analysis and control of inspection effort (Section 2.3.2).

d. The requirement for random sampling from the Index of Primal Tests and in other sampling activities where the inspection population can be clearly identified (Section 2.3.3).

3.3 Inspection Module Distribution

The distribution of inspection modules with respect to program areas was judged to be generally appropriate. All of the inspections addressed subjects which were important to safety. Based on the results of the analysis described in Section 2.4, we concluded that the inspection program for the test phases would be strengthened by the addition of the following specific inspections:

a. Ice condensor systems

b. Secondary steam system relief valves

c. Emergency core cooling system manual relief valves

d. Reactor building ventilation system isolation valves

e. Inspection, test, and operating status (Quality Assurance).

3.4 Overall Program Assessment

The following conclusions were reached based on the overall results of the analyses described in Section 2:

a. The effectiveness of the inspection program could be improved by increasing the manpower investment in inspections performed during the Operations phase. The current level of inspection effort is the lowest of the three phases studied and the rate of noncompliance detection is the highest. Problems occurring in the Operations phase have the most immediate impact on public safety.

   Some increases in the level of inspection effort during the Operations phase would result from implementation of the specific changes detailed in Table 3-1. Additional increases are warranted, and these could be provided by changes to the resident inspection program.

Table 3-1

Potential Increases in Regional Inspection Program

MODULE	TOTAL MANHOURS	NONCOMPLIANCES (V/I/D)*	MANHOURS/ NONCOMPLIANCE	COMMENTS
80710B	4223	0/76/172	17	Environmental Protection. Frequency could be increased to at least twice per year.
41701B	1002	0/28/23	20	Requalification Training. Overall inspection level is low in this area. Frequency could be increased to twice per year. Sample sizes in module could be increased.
82711B	1922	0/66/22	22	Emergency Planning. Frequency and/or sample sizes could be increased.
35747B	161	0/4/3	23	Receipt, Storage and Handling. Overall inspection effort of this area is low. Sample sizes could be increased.
83740B	5764	0/166/76	24	Radiation Protection. Frequency could be increased to at least twice per year.
40700B	1943	0/43/36	25	Onsite Review Committee. Overall inspection effort is low. Sample sizes could be increased.
84710B	4866	0/154/36	26	Radioactive Waste System. Frequency of inspection could be increased to at least twice per year.
83530B	209	0/7/1	26	Radiation Protection. Sample sizes could be increased.
62700B	2237	0/42/33	30	Maintenance. Overall inspection effort is low considering importance of area. Frequency could be increased to at least twice per year. Sample sizes could be increased.

*Violations/Infractions/Deficiencies

Table 3-1 (cont)

MODULE	TOTAL MANHOURS	NONCOMPLIANCES (V/I/D)	MANHOURS/ NONCOMPLIANCE	COMMENTS
82745B	2596	0/75/11	30	Radiation Protection-Refueling. Sample sizes could be increased
71501B	252	0/6/2	32	Technical Specification Compliance. Overall inspection level low for this area. Frequency and/or sample sizes could be increased.
56700B	1738	0/33/17	35	Calibration. Inspection level low for this area. Frequency could be increased to at least twice per year. Sample sizes could be increased.
36100B	285	0/3/5	36	10CFR21 Compliance. Sample size could be increased. Addition of this module to Operations phase inspection program could improve effectiveness.
61700B	1989	0/34/16	40	Surveillance. Frequency could be increased to at least twice per year. Sample sizes could be increased. Effectiveness could be improved by use of checklist developed in Task 2 of this study.
37700B	1853	0/28/17	41	Design, Design Changes and Modifications. Inspection frequency could be increased to at least twice per year. Sample sizes could be increased
71710B	8452	0/143/58	42	Review of Plant Operations. Inspection level is low considering importance of area. Inspection frequency could be increased to monthly. Sample sizes could be increased.
61721B	1234	0/18/8	48	Surveillance of Pipe Supports and Restraints. Frequency could be increased to at least twice per year for available areas. Sample sizes could be increased.

b. An ideal inspection program is one in which inspectors, having detected a problem, examine it further to determine not only the proximate but also the underlying causes. Followup inspection activity is reported under Module 92701. Manhours reported under this module were approximately 5% of the overall inspection effort. No objective data were available to assess the adequacy of this effort. A general impression, however, is that program effectiveness would benefit from additional stress on followup inspection.

c. Approximately 20% of the routine inspection manhours are intended to be used for Independent Inspection (Module 92706B). During the period studied, only about 16% of the inspection effort was reported in this category. The program flexibility and the opportunity to evaluate the licensee administrative programs which arise from Independent Inspections are considered to be valuable parts of the inspection program. It appears that efforts to utilize a full 20% of inspectors' time in this category should be increased.

3.4.1 Potential Increases in Inspection Effort

A list of specific module changes which are judged to be candidates for increased inspection effort is presented in Table 3-1. This table shows, for each module listed, the total manhours reported in the 3-yr period, the number of noncompliances (by violation, infraction, and deficiency), the average manhours expended per noncompliance detected, and pertinent comments.

3.4.2 Potential Decreases in Inspection Effort

A list of specific module changes that are judged to be candidates for decreased inspection effort is presented in Table 3-2.

3.5 Other Conclusions

A significant conclusion from this study is that the type of analysis done provides useful information to managers of the reactor inspection program. The results of such analysis would be more valuable if interpreted by those completely familiar with the inspection program, and if data on deviations could be added to the analysis. With minor changes to the data reporting system and reasonable programming changes for the existing computer-based data processing system, this type of analysis could be reported periodically with little or no additional effort. It is concluded that the production of such reports would be fully warranted.

Based on the effectiveness of inspection and relative importance to safety of areas being addressed, it appears that modules concerning Vibration, Loose Parts Monitoring, and Cranes, Hoists and Lifting Equipment could be removed from the Primal Test Index and added to the lists contained in Modules 70311B and 70329B. Consideration should also be given to (1) broadening the inspection of the Traversing Incore Probe System to encompass the complete neutron monitoring system, and (2) adding the Automatic Depressurization System to the Primal Test Index.

An inspection checklist for review of licensee, maintenance, test and calibration procedures was developed for Task 2 of the study.[1] The use of this checklist could improve the effectiveness of procedure review modules.

Table 3-2

Potential Decreases in Regional Inspection Program

MODULE	TOTAL MANHOURS	NONCOMPLIANCES (V/I/D)	MANHOURS/ NONCOMPLIANCE	COMMENTS
70313B	673	0/0/1		Containment Leak Rate Test. Consider inclusion on primal list as opposed to current 100% application. Large saving in manhours could be realized.
70307B	499	0/0/0		
70323B	180	0/0/0		
	1352	0/0/1	1352	
70301B	915	0/0/1	915	Preoperational test control program inspection. Consider revision to reduce level of inspection effort.
82331B	372	0/0/0		Emergency planning. Consider revision to increase inspection of procedures and of the efficiency of personnel training drills. If effectiveness cannot be increased, consider reduction in level of inspection effort.
82330B	178	0/0/0		
82332B	235	0/0/0		
42452B	222	0/0/0		
	1007	0/0/0	∞	
83320B	308	0/0/0		Radiation Protection. The requirements of these modules could be combined, resulting in reduced manhour investment.
83315B	497	0/0/0		
	805	0/0/0	∞	
92712B	486	0/0/0		Resumption of Normal Operations After Strike. Module could be revised to reduce inspection level.
92709B	91	0/0/0		
92710B	90	0/0/2		
92711B	58	0/0/0		
	725	0/0/2	363	
73051B	586	0/2/0	293	Inservice Inspection Administrative Program. Consider reducing frequency, and/or revising module to reduce inspection load.
72524B	468	0/1/0	468	Initial Fuel load witnessing. Could be revised to reduce inspection level.
84330B	500	0/0/0		Radwaste systems. The requirements of these three modules could be combined, resulting in reduced manhour investment.
84331B	488	0/4/0		
84332B	227	0/0/0		
	1215	0/4/0	304	
80310B	294	0/0/0		Environmental Protection. The requirement of these three modules could be combined, resulting in reduced manhour investment.
80320B	346	0/2/2		
80330B	397	0/0/1		
	1037	0/2/3	207	

APPENDIX A

Inspection Program Areas

A1. General

In order to examine the scope and character of the inspection program, it was divided (and subdivided) into program areas. These are described below.

A2. Reactor Phases

This division identifies the major phases of the inspection program. The phases considered were Preoperational Test, Startup Test, and Operations.

A3. Inspection Categories

These categories are subdivisions of the three major phases. The categories are Routine Inspection, Nonroutine Inspection, Independent Inspection, and Administrative Activities. They are defined in Section 1.4 of this report.

A4. Inspection Subcategories

For the Routine Inspection category only, Inspection subcategories were defined. These are Mitigating Functions, Initiating Events, Quality Assurance, and other Regulatory Requirements.

A4.1 Mitigating Functions

These are functions that, given an initiating event (loss of coolant accident or reactivity transient), prevent a core melt or a large release of radioactive material to the environment.[3] A list of Mitigating Functions and the plant systems which contribute to those functions is shown in Table A-1.

A4.2 Initiating Events

These are events that, in the absence of appropriate mitigating functions, could lead to unacceptable core damage or a large release of radioactive material to the environment. The list of Initiating Events was developed from several sources.[2 4 5 6]

Each initiating event was catalogued according to one of the following major event categories:

a. Reactivity Transient - transients that result from positive reactivity insertions due to control elements, moderator effects, or any unexplained deviation from expected reactivity performance.

b. Reactor Coolant System Pressure Transients - transients resulting in either overpressurization or depressurization of the reactor coolant system, excluding loss of coolant accidents (LOCA's).

c. Reactor/Steam Demand Mismatches - transients resulting in imbalances between the reactor core rate of heat production and the secondary system's rate of heat removal.

d. Reactor Coolant System Heat Removal Transients - factors affecting the ability to transfer heat from the reactor core to the ultimate heat sink.

e. Loss of Coolant Accidents

f. Factors Affecting Core Power Distribution - Although not truly "transients," these are factors that can adversely affect the power distribution of the core, leading to local hot spots and potential local fuel damage. These factors are included as initiating events for IE inspection module categorization.

g. Events Affecting Plant Instrumentation

h. Miscellaneous Initiating Events

The resulting list of initiating events and their causes is contained in Table A-2.

A4.3 10CFR50, Appendix B

The regulatory requirements for quality assurance are represented by the 18 criteria of this appendix. The criteria are listed in Table A-3.

A4.4 Other Routine Inspections

These are inspection activities that were not clearly contained in the above subcategories, but were considered to be important elements of the routine inspection program. Also included here are the inspection program control modules, i.e., those modules which delineate inspection program sampling plans, or which provide general guidance for inspection activities such as procedure review or data review. The list of Other Inspection Activities is shown in Table A-4.

Tables A-1 through A-4 are not structured to indicate the relative significance to safety of the events, functions, or contributing systems. A rank-ordering of this nature would be based largely on probabilistic analysis. The data required to support such an analysis were not available at the time of the study.

A5. Inspection Elements

The smallest program areas addressed are called Inspection Elements. They are the components of the Inspection categories and are listed in Tables A-1 through A-4.

Table A-1

Summary of Mitigating Functions

Pressurized Water Reactor - LOCA

FUNCTION	SYSTEM
Reactor Trip	Reactor Protection
Emergency Cooling Injection	Emergency Cooling Accumulator Upper Head Injection High Pressure Injection
Post Accident Radioactivity Removal	Containment Spray Injection Containment Spray Recirculation Sodium Hydroxide Addition Containment Iodine Removal Penetration Room Ventilation Emergency Gas Treatment
Post Accident Heat Removal	Containment Heat Removal Containment Spray Recirculation Low Pressure Recirculation Containment Air Recirculation Cooling Ice Condenser Air Return Fan Auxiliary Feedwater
Emergency Core Cooling Recirculation	High Pressure Recirculation Low Pressure Recirculation
Containment Integrity	Containment Isolation Main Steam Isolation
Other	Emergency AC Power DC Power Containment Systems Actuation Safety Injection Control

Table A-1 (cont)

Pressurized Water Reactor - TRANSIENT

FUNCTION	SYSTEM
Reactor Subcriticality	Reactor Protection Chemical and Volume Control
Heat Transfer to Environment	Power Conversion Turbine Bypass Secondary Steam Relief Valves Auxiliary Feedwater
Reactor Coolant Overpressure Protection	Pressurizer Safety Relief Valves Open
Reactor Vessel Coolant Volume Control	Chemical and Volume Control Pressurizer Safety Relief Valves Reclose
Other	Emergency AC Power DC Power

Table A-1 (cont)

Boiling Water Reactor - LOCA

FUNCTION	SYSTEM
Reactor Trip	Reactor Protection Control Rod Drive Standby Liquid Control
Post Accident Radioactivity Removal	Vapor Suppression Standby Gas Treatment
Emergency Cooling Injection	Reactor Core Isolation Cooling High Pressure Coolant Injection Main Feedwater Automatic Depressurization Manual Relief Valve Low Pressure Coolant Injection Core Spray Injection
Emergency Coolant Recirculation	Low Pressure Coolant Recirculation Core Spray Recirculation Emergency Service Water
Post Accident Heat Removal	Residual Heat Removal High Pressure Service Water Emergency Service Water
Containment Integrity	Power Conversion/Reactor Vessel Isolation Control Main Steam Isolation Penetration Isolation Valve Reactor Building/Ventilation Isolation Valve Standby Gas Treatment
Other	Emergency AC Power DC Power

Table A-1 (cont)

Boiling Water Reactor - TRANSIENT

FUNCTION	SYSTEM
Reactor Subcriticality	Reactor Protection Control Rod Drive Standby Liquid Control Reactor Coolant Recirculation
Reactor Coolant Overpressure Protection	Safety Relief Valves Open
Vessel Water Inventory	Safety Relief Valves Reclose Main Feedwater High Pressure Coolant Injection Reactor Core Isolation Cooling Low Pressure Coolant Injection Core Spray Injection
Heat Transfer to Environment	Power Conversion Main Steam Isolation Valve Residual Heat Removal High Pressure Service Water Emergency Service Water
Other	Emergency AC Power DC Power

Table A-2

Summary of LWR Initiating Events

Reactivity Transients

EVENT	CAUSES
Control Rod Malfunction	Inadvertent or improper control rod withdrawal (N18.2, WASH-1400, ATWS)*
	Dropped control rod (N18.2, WASH-1400, ATWS)
	Control rod ejection (N18.2, WASH-1400, ATWS)
Moderator/Coolant Anomaly	Inadvertent moderator cooldown (N18.2, ATWS)
	Inadvertent boron dilution (N18.2, WASH-1400, ATWS)
	Startup of inactive reactor coolant system loop (WASH-1400, ATWS)
Miscellaneous	Inadvertent criticality - (reactor restart) (IE)
	Unexplained reactivity insertion (N18.2) (e.g., from improper control rod/fuel assembly placement during fueling; unexplained physics, such as boron concentration, rod worth, moderator temperature and power coefficients, etc.)

Reactor Coolant System Pressure Transients

Depressurization	Pressurizer spray valve malfunction (ATWS)
	Pressurizer relief valve malfunction (small LOCA)
Overpressurization	Inadvertent pressurization during solid water conditions (IE)

*References 4, 5 and 6.

Table A-2 (cont)

Reactor/Steam Demand Mismatches

EVENT	CAUSES
Loss of Load	Generator trip (ATWS) Turbine trip (WASH-1400, ATWS) Loss of condenser cooling (N18.2, WASH-1400) Loss of condenser vacuum (WASH-1400, ATWS) Loss of feedwater flow (N18.2, WASH-1400, ATWS) Inadvertent closure of main steam isolation valves (WASH-1400)
Increase in Load	Secondary steam rupture (N18.2, ATWS) Increase in main feedwater flow rate (WASH-1400) Inadvertent opening of steam generator power operated relief valves (WASH-1400) Inadvertent opening of all turbine bypass valves (WASH-1400, ATWS)
Spurious Activity of Control Elements	Miscellaneous

Reactor Coolant System Heat Removal Transients

Loss of Coolant Flow	Main coolant pump rotors locked (N18.2, WASH-1400) Reactor core blockage (IE) Loss of natural circulation due to gas/vapor binding of potential flow paths
Loss of Feedwater	Main feedwater line rupture (WASH-1400) Loss of condensate pumps (WASH-1400) Loss of condensate boost pumps (IE) Loss of main feedwater pumps (IE) Closure of feedwater regulating valves (IE)

Table A-2 (cont)

Loss of Coolant Accidents

EVENT	CAUSES
Large LOCA	Reactor vessel rupture Steam generator rupture (WASH-1400, ATWS) Pressurizer rupture Double ended pipe break (N18.2, ATWS)
Small LOCA	Pressurizer relief valve malfunction Steam generator tube leak (N18.2) Small line break Control rod drive housing rupture (WASH-1400)

Core Power Distribution

Control Rod Anomaly	Inadvertent removal of single control rod such that Technical Specification safety limits are exceeded (N18.2) Control rod programming error such that Technical Specification safety limits are exceeded (N18.2) Stuck control rod (IE) Improper control rod withdrawal (ATWS)
Core Performance Anomaly	Operation with fuel assembly in improper position such that Technical Specification limits are exceeded (N18.2) Movement of fuel or structure due to core drop (N18.2) Degradation of core thermal/hydraulic/neutronic performance (IE)

Table A-2 (cont)

Events Affecting Plant Instrumentation

Loss of Instrumentation

Loss of one electrical bus (N18.2)
Loss of offsite power (N18.2, WASH-1400, ATWS)
Loss of main generator with failure to shift auxiliary loads to offsite power (WASH-1400)
Station blackout
Uninhabitable control room - remote shutdown (IE)
Miscalibration of instrumentation

Miscellaneous Initiating Events

EVENT	CAUSES
Gaseous Fission Products Released to Primary Coolant	Fuel cladding defects (N18.2)
Human Error	Single error by operator (N18.2) Violation of pressure/temperature limits for criticality (IE) Refueling accidents

Table A-3

10CFR50 Appendix B

Organization
Quality Assurance Program
Design Control
Procurement Document Control
Instructions, Procedures, and Drawings
Document Control
Control of Purchased Material, Equipment, and Services
Identification and Control of Materials, Parts, and Components
Control of Special Processes
Inspection
Test Control
Control of Measuring and Test Equipment
Handling, Storage and Shipping
Inspection, Test, and Operating Status
Nonconforming Materials, Parts, or Components
Corrective Action
Quality Assurance Records
Audits

Table A-4

Other Routine Inspections

Surveillance

Maintenance

Calibration

Organization and Training

Emergency Planning

Public Exposure

Occupational Exposure

10CFR21 Requirements

Plant Status

Inspection Program Control

APPENDIX B

Review of Individual Modules

B1. General

Inspection modules that apply to the regional inspection program for the Preoperational Test, Startup Test, and Operations phases were determined from the applicable enclosures in IE Manual Chapters 2513, 2414, and 2515. Likewise, the inspection modules for the resident inspection program for these three phases were determined from the applicable Enclosures in IE Manual Chapters 2593, 2594, and 2595. Each inspection module listed in these enclosures was reviewed and the results of each review were recorded on an "Evaluation of Inspection Module" form shown in Figure B-1.

B2. Use of Module Evaluation Form

B2.1 Module No.

The number of the module being evaluated was recorded.

B2.2 Module Title

The title of the module being evaluated was entered.

B2.3 Inspection Phase

The numeric 3, 4 and/or 5 was circled to indicate whether the module applied to the Preoperational, Startup, and/or Operations phase.

B2.4 Inspection Frequency

The frequency of inspections was entered, e.g., Q = Quarterly, 1 = once (used primarily in Preoperational Testing and Startup Testing phases).

B2.5 Inspection Methods Used

The inspection methods used by IE were categorized as

a. Review of Procedures

b. Review of Records

c. Interview of Personnel

d. Witnessing Activities

e. Observation of Facility Conditions

The inspection requirements of a module were reviewed to determine which of these inspection methods was used and whether the method was adequate to satisfy the objective(s) of the module. A "Y" was recorded when an inspection method was adequate, and an "N" was recorded when the method was considered inadequate. For the latter case, space is provided under "Comments" to explain the inadequate rating. When an inspection method did not apply, a check mark was recorded.

B2.6 Program Definition

When the inspection requirements in a module necessitated a review of procedures or other documents for accuracy and completeness, the numeric 1 was recorded adjacent to Program Definition, i.e., Inspection method 1 was used (Review Procedures).

B2.7 Program Implementation

When the inspection requirements in a module indicated a review of records, interviews of personnel, witnessing of activities, or observance of facility conditions, the appropriate numeric(s) was recorded adjacent to Program Implementation for the inspection method(s) used.

B2.8 Related Inspection Modules

When the module being evaluated referenced other inspection modules, these were recorded in this space. Such modules were also reviewed to determine their relationship to the module being evaluated.

B3. Results

B3.1 Approximately 350 modules in the Preoperational Test, Startup Test, and Operations phases were reviewed. In general, this review indicated that the format of the inspection modules was appropriate and module objectives were satisfactorily verified by their inspection requirements. However, in some of the modules it was noted that all objectives were not completely verified by their inspection requirements. One such module is shown in Figure B-2. The need for additional guidance in many modules was also noted.

B3.2 In a few modules, such as 70303B, 70312B, and 70321B (which include the PWR and BWR index of primal tests), the IE inspector is required to select a sample size from the applicable (PWR or BWR) primal tests index. In order that each test be given an equal chance of being selected, these modules should require random sampling.

B3.3 The inspection frequency specified for some modules (such as 38701B "Procurement Program" and 38702B "Receipt, Storage, Handling of Equipment and Materials Program") was every three years. The time span between inspections for these two important programs appears to be excessive. An annual inspection frequency is considered more appropriate.

B3.4 During the study, a number of findings and comments resulting from the review of inspection modules were forwarded to IE for their consideration.

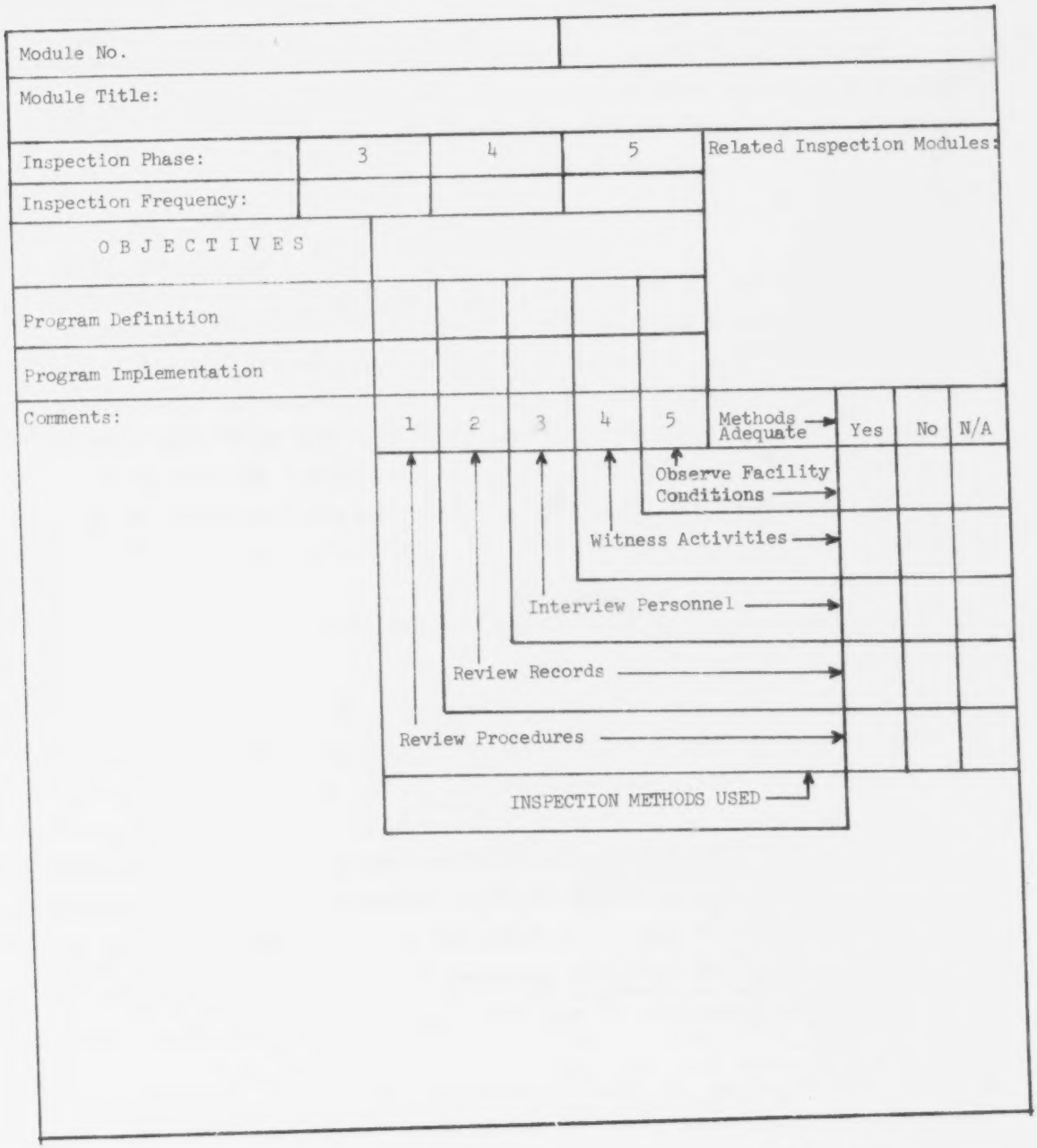


Figure B-1. Evaluation of Inspection Module

Module No. 70315B					Reviewed by:			
Module Title: ENGINEERED SAFETY FEATURES TEST-PREOPERATIONAL TEST WITNESSING								
Inspection Phase:	(3)	4	5		Related Inspection Modules: None			
Inspection Frequency:	1							
OBJECTIVES								
Program Definition	1							
Program Implementation		2		4	5			
Comments: Section I - Objective No. 2 reads "Independently verify acceptability of test results." Section II - Inspection Requirement 4d reads "Verify that test data is collected and recorded in the approved manner." The inspection requirement does not meet objective No. 2	1	2	3	4	5	Methods Adequate	Yes	No	N/A
						Observe Facility Conditions →	Y		
						Witness Activities →	Y		
						Interview Personnel →			✓
						Review Records →		N	
						Review Procedures →	Y		
						INSPECTION METHODS USED			

Figure B-2. Sample of Completed "Evaluation of Inspection Module" Form

APPENDIX C

Association of Inspections With Program Areas

C1. General

Each inspection module in the Preoperational Test, Startup Test, and Operations phases for both the regional and the resident inspection programs was reviewed to determine the program areas addressed by the module inspection requirements. (See Section 2 for a description of program areas.) Tables C-1 through C-9, listed below, show the results of that review.

C1.1 Routine Inspection

Table C-1 Modules for Mitigating Functions PWR-LOCA

Table C-2 Modules for Mitigating Functions PWR-Transient

Table C-3 Modules for Mitigating Functions BWR-LOCA

Table C-4 Modules for Mitigating Functions BWR-Transient

Table C-5 Modules for Initiating Events PWR

Table C-6 Modules for Initiating Events BWR

Table C-7 Modules for Quality Assurance - 10CFR50 Appendix B

Table C-8 Modules for Other Routine Inspections

C1.2 Nonroutine Inspection

Table C-9, Modules for Nonroutine, Independent, and Administrative Inspections.

C1.3 Independent Inspection

Table C-9, Modules for Nonroutine, Independent, and Administrative Inspections.

C1.4 Administrative

Table C-9, Modules for Nonroutine, Independent, and Administrative Inspections.

With the exception of Column 1 the format for each of the tables is the same. Column 1 in each table varies according to the function, event, or activity being inspected. Columns 2 and 3 contain a list of inspection modules associated with these regulatory elements for the Preoperational Test phase. Similarly, columns 4 and 5 list inspection modules for the Startup Test phase, and columns 6 and 7 list inspection modules for the Operations phase.

C2. Procedure

The inspection modules for each phase of the regional and resident inspection programs were evaluated to determine their associated inspection elements. Each module was then reviewed to determine which function, event, or activity it pertained to. For example, it was determined that inspection module 70337B, "Main Steam Isolation Valve Test," in the Preoperational Test phase applied to PWR-LOCA (Table C-1), to BWR-LOCA and Transient (Tables C-3 and C-4), and to the mitigating function "Containment Integrity." It was also determined that this module applied to the PWR (Table C-5) and BWR (Table C-6) initiating event "Reactor/Steam Demand Mismatch" under the cause, "Loss of Load." In all cases, module 70337B was recorded in the "Definition" column only, since the module dealt with procedure review.

A second example of the association of an inspection module with the regulatory elements is found in Table C-8, "Modules for Other Routine Inspections." It was determined that inspection modules 62700B (in the regional inspection program) and 62700C (in the resident inspection program), both titled "Maintenance," pertained to inspections during the Operations phase. Accordingly, these modules are listed adjacent to Maintenance and under Operations. Since the inspections required in these modules pertained to (1) the use of an approved procedure, (2) the review

of records, (3) the witnessing of activities and (4) the observation of facility conditions, both of these modules were entered in the Implementation column (62700B,C) under Operations.

C3. Results

For the most part, there appears to be adequate inspection coverage for all of the regulatory elements. However, a few areas in the resultant tables do show a low level of inspection coverage in the Preoperational Test and Startup Test phases:

C3.1 In Table C-1 under Post Accident Heat Removal, no inspection module was found that specifically covered the inspection of the Ice Condenser System.

C3.2 In Table C-2 under Heat Transfer to Environment, no inspection module was found that specifically covered the inspection of the Secondary Steam Relief Valve.

C3.3 In Table C-3 under Emergency Core Cooling Injection and under Containment Integrity, no inspection module was found that specifically covered the inspection of the Manual Relief Valve or the Reactor Building-Ventilation System Isolation Valve, respectively.

C3.4. In Table C-7 under Inspection, Test and Operating Status, no inspection module was found that covered these 10CFR50 Appendix B requirements.

C4. In a few instances it was found that the inspection requirement applicability was so broad that their association with specific systems could not be made. Such was the case in Tables C-1 through C-6 where, under the Operations column, modules 61700B and C (Surveillance) and 62700B and C (Maintenance) are shown as associated with all mitigating and initiating systems. This association is shown since these modules refer to the "safety related system" and since their direct association with the specific subsystems and components in column 1 of these tables was indeterminate.

C5. In Table C-1 it appears that there is almost a complete lack of inspection effort for pressurized water reactors in the Startup phase. This is because it is customary to perform functional testing on systems and components as soon as practicable; and optimum time for testing pressurized water reactors is during the Preoperational Test phase. This is evident by the preponderance of modules covering testing that are shown under the Preoperational column in Table C-1.

Conversely, in Table C-3, which covers boiling water reactors, more testing is shown in the Startup Test phase, since many tests cannot be performed during BWR preoperational testing, e.g., Hot Functional Test. In the construction of Tables C-1 through C-4, however, we are not implying that all systems and components should be tested in both the Preoprational Test phase and the Startup Test phase.

Table C-1

Modules for Mitigating Functions PWR-LOCA

PWR FUNCTIONS-LOCA	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactor Trip						
- Reactor Protection	70305B 70317B 70332B 70334B	70317B 70325B 70432B 70434B 70532B 70534B	72500B 72564B 72568B 72586B	72521C 72524B,C	61700B 61705B	61700B,C 61705B,C 62700B,C 71711B
Emergency Core Cooling Injection						
- Accumulator	70304B 70315B	70315B 70322B			61700B	61700B,C 62700B,C 71711B
- Upper Head Injection	70304B 70315B	70315B 70322B			61700B	61700B,C 62700B,C 71711B
- High Pressure Injection	70304B 70315B	70315B 70322B			61700B	61700B,C 62700B,C 71711B
- Low Pressure Injection	70304B 70315B	70315B 70322B			61700B	61700B,C 62700B,C 71711B
Post Accident Radiation Removal						
- Containment Spray Injection	70304B 70315B 70343B	70315B 70322B 70443B 70543B			61700B	61700B,C 62700B,C
- Containment Spray Recirculation	70308B 70339B 70343B 70359B	70324B 70439B 70443B 70459B 70539B 70543B 70559B			61700B	61700B,C 62700B,C
- Sodium Hydroxide Addition	70343B	70443B 70543B			61700B	61700B,C 62700B,C
- Containment Iodine Removal	70345B	70445B 70545B			61700B	61700B,C 62700B,C
- Penetration Room Ventilation	70346B	70446B 70546B			61700B	61700B,C 62700B,C
- Emergency Gas Treatment	70304B 70315B	70315B 70322B				
Post Accident Heat Removal						
- Containment Heat Removal	70304B 70308B 70315B 70339B 70345B 70359B	70315B 70322B 70439B 70445B 70459B 70539B 70545B 70559B			61700B	61700B,C 62700B,C
- Containment Spray Recirculation	70308B 70324B 70339B 70343B 70359B	70324B 70439B 70443B 70459B 70539B 70543B 70559B			61700B 61700B	61700B,C 62700B,C 61700B,C 62700B,C
- Low Pressure Recirculation	70308B 70324B 70339B 70359B	70324B 70439B 70459B 70539B 70559B			61700B 61700B	61700B,C 62700B,C 61700B,C 62700B,C
- Containment Air Recirculation Cooling	70345B	70445B 70545B			61700B	61700B,C 62700B,C
- Ice Condensor					61700B	61700B,C 62700B,C
- Air Return Fan	70345B	70445B 70545B			61700B	61700B,C 62700B,C
- Auxiliary Feedwater	70338B	70438B 70538B				
Emergency Core Cooling Recirculation						
- High Pressure Recirculation	70339B 70359B	70439B 70459B 70539B 70559B			61700B	61700B,C 62700B,C 71711B
- Low Pressure Recirculation	70308B 70324B 70339B 70359B	70324B 70439B 70459B 70539B 70559B			61700B	61700B,C 62700B,C 71711B
Containment Integrity						
- Containment Isolation	70307B 70342B 70344B	70313B 70323B 70442B 70444B 70542B 70544B			61700B	61700B,C 62700B,C
- Main Steam Isolation Valves	70337B	70437B 70537B			61700B	61700B,C 62700B,C
Other						
- Emergency AC Power	70306B 70316B 70341B	70316B 70326B 70441B 70541B	72582B 72586B	72528B 72530B,C 72600B 72604B	61700B 61701B	61700B,C 61701B 62700B,C
- DC Power System	70306B 70316B 70340B	70316B 70326B 70440B 70540B	72582B 72586B	72528B 72530B,C 72600B 72604B	61700B 61701B	61700B,C 61701B 62700B,C
- Containment System Actuation	70343B	70443B 70543B			61700B	61700B,C 62700B,C
- Safety Injection Control	70304B 70315B	70315B 70322B			61700B	61700B,C 62700B,C

Table C-2

Modules for Mitigating Functions PWR-Transient

PWR FUNCTIONS-TRANSIENT	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactor Subcriticality - Reactor Protection	70305B 70317B 70332B 70333B	70317B 70325B 70432B 70532B 70433B 70533B	72500B 72564B 72568B 72586B	72521C 72524B,C	61700B 61705B 61700B	61700B,C 61705B,C 62700B,C 71711B 61700B,C 62700B,C
- Chemical and Volume Control						
Heat Transfer to Environment - Power Conversion - Turbine Bypass - Secondary Steam Relief Valves - Auxiliary Feedwater	70348B 70338B	70448B 70548B 70438B 70538B	72514B 72580B		61700B 61700B 61700B 61700B	61700B,C 62700B,C 61700B,C 62700B,C 61700B,C 62700B,C 61700B,C 62700B,C
Reactor Coolant System Overpressure Protection - Pressurizer Safety Relief Valves	70335B	70435B 70535B			61700B 61701B 62701B	61700B,C 61701B 62700B,C 62701B
Reactor Vessel Coolant Volume Control - Chemical and Volume Control System - Pressurizer Safety Relief Valves	70333B 70335B	70433B 70533B 70435B 70535B			61700B 61700B 61701B 62701B	61700B,C 62700B,C 61700B,C 61701B 62700B,C 62701B
Other - Emergency AC Power System - DC Power System	70306B 70316B 70341B 70306B 70316B 70340B	70316B 70326B 70441B 70541B 70316B 70326B 70440B 70540B	72582B 72586B 72582B 72586B	72528B 72530B,C 72600B 72604B 72528B 72530B,C 72600B 72604B	61700B 61701B 61700B 61701B	61700B,C 61701B 62700B,C 61700B,C 61701B 62700B,C

Table C-3

Modules for Mitigating Functions BWR-LOCA

BWR FUNCTIONS-LOCA	PREOPERATIONAL				STARTUP				OPERATIONS			
	Definition		Implementation		Definition		Implementation		Definition		Implementation	
Reactor Trip - Reactor Protection	70305B	70317B	70317B		72500B		70325B	72524B,C	61700B		61700B,C 61704B,C 71711B	61703B,C 62700B,C
- Control Rod Drive	70305B	70332B	70432B	70532B	72504B 72508B	72506B 72520B	72528B,C	72531B	61700B		61700B,C	62700B,C
- Standby Liquid Control	70356B		70456B	70556B					61700B		61700B,C	62700B,C
Post Accident Radioactivity Removal - Vapor Suppression	70304B	70315B	70315B	70322B					61700B		61700B,C	62700B,C
- Standby Gas Treatment	70304B	70315B	70315B	703223					61700B		61700B,C	62700B,C
Emergency Core Cooling Injection - Reactor Core Isolation Cooling	70304B	70357B	70322B 70557B	70457B	72512B	72520B	72532B	72536B	61700B		61700B,C 71711B	62700B,C
- High Pressure Coolant Injection	70304B	70315B	70315B	70322B	72508B	72520B	72528B,C 72536B 72528C	72532B	61700B		61700B,C 71711B	62700B,C
- Main Feedwater	70348B		70448B	70548B					61700B		61700B,C	62700B,C
- Automatic Depressurization	70304B	70315B	70315B	70322B					61700B		61700B,C	62700B,C
- Manual Relief Valve									61700B		61700B,C	62700B,C
- Low Pressure Coolant Injection	70304B	70315B	70315B	70322B	70308B	70324B	70324B		61700B		61700B,C 71711B	62700B,C
- Core Spray Injection	70304B	70315B	70315B	70322B	70308B	70324B	70324B		61700B		61700B,C	62700B,C
Emergency Coolant Recirculation - Low Pressure Coolant Recirculation	70315B	70359B	70315B 70459B	70322B 70559B					61700B		61700B,C 71711B	62700B,C
- Core Spray Recirculation	70359B		70459B	70559B					61700B		61700B,C	62700B,C
- Emergency Service Water	70336B		70436B	70536B					61700B		61700B,C	62700B,C
Post Accident Heat Removal - Residual Heat Removal	70336B		70436B	70536B	70308B	70324B	70324B		61700B		61700B,C	62700B,C
- High Pressure Service Water	70336B		70436B	70536B					61700B		61700B,C	62700B,C
- Emergency Service Water	70336B		70436B	70536B					61700B		61700B,C	62700B,
Containment Integrity - Power Conversion/Reactor Vessel Isolation Control	70305B 70317B	70307B 70342B	70313B 70323B 70542B	70317B 70442B					61700B		61700B,C	62700B,C
- Main Steam Isolation Valve	70337B		70325B 70537B	70437B	72504B 72510B	72506B 72520B	72528B,C 72532B 72540B 72548B	72531B 72536B 72544B 72551B	61700B	62701B	61700B,C 62701B	62700B,C
- Penetration Isolation Valve	70344B		70444B	70544B					61700B		61700B,C	62700B,C
- Reactor Building/Ventilation Isolation									61700B,		61700B,C	62700B,C
- Standby Gas Treatment	70304B	70315B	70315B	70322B					61700B		61700B,C	62700B,C
Other - Emergency AC Power	70306B 70341B	70316B	70316B 70441B	70326B 70541B	72516B	72520B	72528B 72532B	72530B,C 72536B	61700B	61701B	61700B,C 62700B,C	61701B
- DC Power	70306B	70340B	70440B	70540B	72516B	72520B	72528B 72532B	72530B,C 72536B	61700B	61701B	61700B,C 62700B,C	61701B

Table C-4

Modules for Mitigating Functions BWR-Transient

BWR FUNCTIONS - TRANSIENT	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactor Subcriticality - Reactor Protection	70305B 70317B	70317B	72500B	70325B 72524B,C	61700B	61700B,C 61703B,C 61704B,C 62700B,C 71711B
- Control Rod Drive	70305B 70332B	70432B 70532B	72504B 72506B 72508B 72520B	72528B,C 72531B	61700B	61700B,C 62700B,C
- Standby Liquid Control	70356B	70456B 70556B			61700B	61700B,C 62700B,C
- Reactor Coolant Recirculation	70359B	70459B 70559B	72512B		61700B	61700B,C 62700B,C
Reactor Coolant System Overpressure Protection - Safety Relief/Valves	70335B	70435B 70535B	72510B 72520B	72528B,C	61700B 61701B 62701B	61700B,C 61701B 62700B,C 62701B
Vessel Water Inventory - Safety Relief/Valves	70335B	70435B 70535B	72510B 72520B	72528B,C	61700B 61701B 62701B	61700B,C 61701B 62700B,C 62701B
- Main Feedwater	70348B	70448B 70548B		72528C	61700B	61700B,C 62700B,C
- High Pressure Coolant Injection	70304B 70315B	70315B 70322B	72508B 72520B	72528B,C 72532B 72536B	61700B	61700B,C 62700B,C 71711B
- Reactor Core Isolation Cooling	70357B	70457B 70557B	72512B 72520B	72532B 72536B	61700B	61700B,C 62700B,C 71711B
- Low Pressure Coolant Injection	70304B 70315B	70315B 70322B	70308B 70324B	70324B	61700B	61700B,C 62700B,C 71711B
- Core Spray Injection	70304B 70315B	70315B 70322B	70308B 70324B	70324B	61700B	61700B,C 62700B,C
Heat Transfer to Environment - Power Conversion	70348B	70448B 70548B			61700B	61700B,C 62700B,C
- Main Steam Isolation Valve	70337B	70325B 70437B 70537B	72504B 72506B 72510B 72520B	72528B,C 72531B 72532B 72536B 72540B 72544B 72548B 72551B	61700B 62701B	61700B,C 62700B,C 62701B
- Residual Heat Removal	70336B	70436B 70536B	70308B 70324B	70324B	61700B	61700B,C 62700B,C
- High Pressure Service Water	70336B	70436B 70536B			61700B	61700B,C 62700B,C
- Emergency Service Water	70336B	70436B 70536B			61700B	61700B,C 62700B,C
Other - Emergency AC Power	70306B 70316B 70341B	70316B 70326B 70441B 70541B	72516B 72520B	72528B 72530B,C 72532B 72536B	61700B 61701B	61700B,C 61701B 62700B,C
- DC Power	70306B 70340B	70440B 70540B	72516B 72520B	72528B 72530B,C 72532B 72536B	61700B 61701B	61700B,C 61701B 62700B,C

Table C-5

Modules for Initiating Events PWR

PWR EVENTS	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactivity Transients Control Rod	70332B	70432B 70532B	72564B 72570B 72572B 72584B 72586B 72592B,C 72598B	72521C 72522C 72528B,C 72574B 72592B,C 72598B 72600B 72604B	61700B 61705B 61706B	61700B,C 61705B,C 61706B,C 61710B 62700B,C
Moderator/Coolant	70333B	70433B 70533B	72570B 72572B 72586B 72592B,C 72598B	72574B 72576B 72592B,C 72598B 72600B 72604B 72608B 72612B 72620B 72624B 72628B	61700B	61700B,C 61708B,C 61709B 62700B,C
Miscellaneous			72500B 72572B 72592B,C	72522C 72524B,C 72574B 72592B,C	61700B 61707B 86700B	61700B,C 61707B,C 61708B,C 61709B 61710B 62700B,C 86700B 86714B
RCS Pressure Transients	70335B 70347B	70435B 70447B 70535B 70547B	72566B 72568B	72521C 72528B,C 72576B	61700B	61700B,C 62700B,C
Reactor/Steam Demand Mismatch Loss of Load	70308B 70324B 70337B	70324B 70437B 70537B	72580B 72586B	72521C 72528B,C 72530B,C 72624B 72628B	61700B	61700B,C 62700B,C
Increase in Load	70308B 70324B 70370B	70324B 70370B,C	70370B	70370B,C	61700B 61721B	61700B,C 61721B,C 62700B,C
Spurious Activity of Control Elements	70308B 70324B 70348B	70324B 70448B 70548B	72586B	72608B 72624B	61700B	61700B,C 62700B,C
RCS Heat Removal Transients	70308B 70324B 70336B	70324B 70436B 70536B	72586B	72600B 72604B	61700B	61700B,C 62700B,C
Loss of Coolant Accidents	70349B 70370B	70370B,C 70449B 70549B	70370B 72566B	70370B,C 72521C	61700B 61721B	61700B,C 61721B,C 62700B,C
Core Power Distribution			72500B 72578B 72584B 72598B	72522C 72524B,C 72528B,C 72598B 72604B 72608B 72612B 72616B 72620B 72628B	61700B 61702B,C 61705B 61706B	61700B,C 61702B,C 61705B,C 61706B,C 61711B,C 62700B,C
Events Affecting Plant Instrumentation	70306B 70316B 70317B 70340B 70341B 70346B 70351B 70352B 70354B 70355B	70316B 70317B 70325B 70326B 70440B 70441B 70446B 70451B 70452B 70454B 70455B 70540B 70541B 70546B 70551B 70552B 70554B 70555B	72500B 72564B 72568B 72570B 72582B 72586B 72592B,C 72598B	72521C 72522C 72524B,C 72528B,C 72530B,C 72592B,C 72598B 72600B 72604B	61700B 61705B 61706B	61700B,C 61705B,C 61706B,C 62700B,C
Miscellaneous Initiating Events	42702B 60501B 70304B 70305B 70331B 70333B 70350B 70353B	42702B,C 60501B,C 70314B,C 70431B 70433B 70450B 70453B 70531B 70533B 70550B 70553B		60502C	60705B 60706C 60710B 61700B 86700B 86712B	60705B,C 60706C 60710B,C 61700B,C 62700B,C 71711B 71712C 84710B,C 86700B 86712B

Table C-6

Modules for Initiating Events BWR

BWR EVENTS	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactivity Transients Control Rod	70332B	70432B 70532B	70308B 72502B 72504B 72506B 72508B 72520B	70314B 70324B 72526B,C 72528B,C	61700B 61706B	61700B,C 61703B,C 61704B,C 61706B,C 62700B,C
Moderator/Coolant Miscellaneous	70356B	70456B 70556B	72500B 72502B	72524B,C 72526B,C	61700B 61700B 61707B 86700B	61700B,C 62700B,C 61700B,C 61707B,C 62700B,C 86700B 86714B
RCS Pressure Transients	70335B	70435B 70535B		72528B,C	61700B	61700B,C 62700B,C
Reactor/Steam Demand Mismatch Loss of Load	70337B	70437B 70537B	70308B 72510B 72514B 72520B	70314B 70324B 72528B,C 72530B,C 72554B 72558B	61700B	61700B,C 62700B,C
Increase in Load	70370B	70370B,C	70308B 70370B 72504B 72506B	70314B 70324B 70370B,C	61700B 61721B	61700B,C 61721B,C 62700B,C
Spurious Activity of Control Elements	70348B	70448B 70548B	70308B	70314B 70324B 72544B	61700B	61700B,C 62700B,C
RCS Heat Removal Transients	70336B 70357B	70436B 70457B 70536B 70557B	70308B	70314B 70324B 72532B 72540B 72558B	61700B	61700B,C 62700B,C
Loss of Coolant Accidents	70370B	70370B,C	70370B 72504B	70370B,C	61700B 61721B	61700B,C 61721B,C 62700B,C
Core Power Distribution			70308B 72506B 72500B 72512B 72504B 72518B	72524B,C 72526B 72528B,C 72532B 72536B 72548B 72558B	61700B 61702B,C 61706B	61700B,C 61702B,C 61703B,C 61704B,C 61706B,C 62700B,C
Events Affecting Plant Instrumentation	70306B 70316B 70317B 70340B 70341B 70352B 70355B 70358B 70360B	70316B 70317B 70325B 70326B 70440B 70441B 70452B 70455B 70458B 70460B 70540B 70541B 70552B 70555B 70558B 70560B	72500B 72512B 72516B 72520B	70325B 72524B,C 72526B,C 72528B,C 72530B,C	61700B 61704B 61706B	61700B,C 61703B,C 61704B,C 61706B,C 62700B,C
Miscellaneous Initiating Events	42702B 60501B 70304B 70305B 70331B 70350B 70353B 70361B	42702B,C 60501B,C 70431B 70450B 70453B 70461B 70531B 70550B 70553B 70561B		60502C 70314B,C	60705B 60706C 60710B 61700B 86700B 86712B	60705B,C 60706C 60710B,C 61700B,C 62700B,C 71711B 71712C 84710B,C 86700B 86712B

Table C-7

Modules for Quality Assurance - 10CFR50 Appendix B

CRITERIA	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Organization	35301B	35301B,C			35751B	
Quality Assurance Program	30301B 35301B	35301B,C	35740B		35701B,C 35751B	
Design Control			35744B	35744B	37702B	37700B,C 37701B
Procurement Document Control			35746B	35746B	38701B	38701B
Instructions Procedures Drawings	42702B	37301C 42450B 42451B 42452B 42702B,C 70311B	72300B		37702B	37700B,C 37701B
Document Control	35301B 42400B	35301B,C 42400B	35742B 35744B	35742B 35744B	37702B 39702B	39702B
Control of Purchased Material, Equipment and Services			35746B 35747B	35746B 35747B	38701B 38702B	38700C 38701B 38702B
Identification and Control of Materials, Parts and Components			35747B	35747B		38700C
Control of Special Processes						
Inspection	35301B	35301B	35744B	35744B		
Test Control	35301B 70301B	35301B,C 70302B,C 70312C	35501B 35749B 72400B	35501B 35749B	37703B	37703B 63700B 72700B,C 72701B
Control of Measuring and Test Equipment	35301B	35301B,C	35501B 35745B 35750B 72400B	35501B 35745B 35750B	61724B	
Handling Storage and Shipping			35747B	35747B	38702B	38700C 38702B
Inspection, Test and Operating Status						
Nonconforming Materials, Parts, or Components			35747B	35747B		
Corrective Action	35301B	35301B,C	35501B	35501B		
Quality Assurance Records	35301B 39301B	35301B 39301B	35501B 35748B	35501B 35748B	39701B	39701B
Audits	35301B	35301B	35501B 35741B	35501B,C 35741B	40702B	40702B

Table C-8

Modules for Other Routine Inspections

	PREOPERATIONAL				STARTUP		OPERATIONS			
	Definition		Implementation		Definition	Implementation	Definition		Implementation	
Surveillance	35301B		35301B,C		35745B	35745B	61700B 61721B 73051B	61702B,C 61725B 73052B	61700B,C 61702B,C 61720C 73753B	61701B 61719C 61721B,C 73755B
Maintenance			42451B		35743B	35743B	62701B	62702B	62700B,C	62701B
Calibration					35745B	35745B	56700B 61725B	56701B	56700B,C	56701B,C
Organization and Training	35301B 41301B	40301B	35301B,C 40301B	36301B 41301B,C			36701B 40701B	40700B 40703B	36700B,C 40701B 41700B,C	40700B,C 40703B 41701B,C
Emergency Planning	42702B 82331B	82330B 82332B	42452B 82330B 82332B	42702B,C 82331B,C			42703B 92710B,C	92709B	42703B 82711B 92709B,C 92711B,C	82710B,C 82712B 92710B,C 92712B,C
Public Exposure	80310B 84331B	84330B 84332B	80310B 80330B 84331B	80320B,C 84330B,C 84332B		84530B,C	84711B 86712B	86700B	80710B,C 84711B 86712B 86716B 86720B	84710B,C 86700B 86714B 86718B
Occupational Exposure	83315B	83320B	83315B,C	83320B		83530B,C	83745B	86700B	83740B,C 86700B	83745B
10CFR21 Requirements					36100B	36100B				
Plant Status			42450B 91300B	71302C		71501B,C	54701B	90714B	42700B 71711B	71710B,C 71712C
Inspection Program Control (IE)	70303B 71301B	70329B	70300B 70312B 70329B	70311B 70320B 70400B	72300B	72301B				

Table C-9

Modules for Nonroutine, Independent, and Administrative Inspections

	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Nonroutine Inspection	90711B 92700C	90711B 90712C 92700C 92701B 92702B 92703B 92704B 92705B 92715B 92716B 93700B,C 93701B 94300B	92700C	90501B,C 90712C 92700C 92701B 92702B 92703B 92704B 92705B 93700B,C 93701B	55700B 92700B,C	55700B 57700B 90712B,C 90713B 92700B,C 92701B 92702B 92703B 92704B 92705B 92715B 92716B 93700B,C 93701B 94701B
Independent Inspection	92706B	92706B	92706B	92706B	92706B	92706B
Administrative	30301B 30703B,C 71301B 82310B 83310B 84310B	35030B 94600C	30703B,C	35030B 94600C	30700B 30702B 30703B,C	35030B 94600C

APPENDIX D

Calculation of Average Manhours Invested in Inspection Modules

D1. General

In order to assess the extent to which the IE program manhour investment in inspections is commensurate with the effectiveness of the inspections in evaluating risk, it was necessary to determine the manhours invested in each completion of an inspection module. Data from the IE Office indicated the total manhours charged to each module and the number of inspections reported for each module. This appendix describes the data provided by IE, and the methods used to derive manhour investment based on that data.

D2. Data From the Office of Inspection and Enforcement

The Office of Inspection and Enforcement provided data for the period January 1976 through December 1978 on each regional inspection module, and for the period January 1, 1978, through June 1, 1979, on each resident inspection module, for the phases covered by the study. The data were compiled from the Statistical Data Reporting System and presented as computer listings. An example of these listings is shown in Figure D-1, titled "Direct Inspection Effort and Noncompliances for Closed Modules."

The data used from the IE listings included the actual manhours, and the number of inspections, violations, infractions, and deficiencies. This information was compiled and summarized for each module. The compilations of NRC data are shown in the first six columns of Tables D-1 through D-3 for regional inspection modules, and in similar columns of Tables D-4 through D-6 for resident inspection modules.

D3. Calculation of Manhours per Reactor for Each Module

The calculation of manhours required per reactor for each test phase involved determining the number of times the module was completed during the time period covered by the analysis, and dividing that number into the total manhours reported.

D3.1 Determining Number of Module Completions for Regional Inspections

The number of times that a regional inspection module was completed during the period studied was determined as follows:

1. The Test and Operations phases for each commercial power reactor were determined from references 7, 8, and 9. If all or part of these phases fell in the period January 1976 through December 1978, they were plotted on a calendar chart (Charts D-1 and D-2).

2. The total activity of a phase in the period studied was calculated by counting the number of reactor months in that phase. This number was divided by the number of months generally required for the phase. As an example, look at Chart D-1 for the Preoperational Test phase. Thirty-four reactors were in the Preoperational Test phase during the 3-yr period being analyzed. A total of 272 months of Preoperational Test activity took place at these reactors. This figure (272) was divided by 18, since a typical Preoperational Test phase was assumed to require 18 months. The result, 15.1, is taken as the equivalent number of reactor Preoperational Test phases. A similar calculation was performed for the Startup Test phase (Chart D-2) except that the total months of startup testing activity were divided by 9 (assuming an average Startup phase 9 months in duration). For the Operations phase (Chart D-2), the total number of operating reactor months was divided by 12 to obtain equivalent reactor years of operation.

D3.2 Determining Manhours per Module in a Reactor Phase

The average manhours invested in each module for one reactor in a given phase were determined by dividing the total manhours charged to the module by the number of equivalent reactor phases. For example, Module 70313 in Table D-1 has a total of 673 manhours charged to it in the period studied. Since this time is assumed to have been accumulated during 15.1 reactor Preoperational Test phases, the average manhours per reactor Preoperational Test phase was 673 divided by 15.1, or 45 hr, rounded to the nearest hour (see column titled "Manhours/Reactor").

D3.3 Calculations for Regional Modules Not Used for All Reactors

Many of the modules covered in the study were not implemented for all of the applicable reactors. In some cases, the module was issued subsequent to January 1, 1976. Consequently, the total manhours reported were accumulated during few applications. To determine the average manhours per phase for these modules, the number of applications (number of phases or number of reactor years) had to be calculated from Charts D-1 and D-2. For example, see Module 70370 in Table D-1. The total manhours charged to this module are 143. However, the module did not become effective until April of 1977. As a result it was necessary to determine the number of opportunities for application (number of reactor Preoperational Test phases) between April 1977 and December 1978. From Chart D-1, it was determined that 176 months of preoperational testing occurred in the period, or 176/18 equivalent Preoperational Test phases (9.78). The average number of manhours per module application was then the total manhours charged (143) divided by the number of applications (9.78), or 15.

In the case described above, the module was not implemented for all reactors studied because it was not issued at the beginning of the study period. In addition, some modules were not implemented for all reactors because they were specific to either boiling water reactor (BWR) or pressurized water reactor (PWR) designs. Note that Charts D-1 and D-2 identify the reactor type. For those modules which were design-specific

(i.e., BWR or PWR), module applications were calculated based on data for the appropriate reactors.

D3.4 Calculations for Resident Inspection Modules

The same methods were used to calculate manhours for resident inspection modules as those used for regional inspection modules, with two exceptions:

1. As previously noted, the resident inspection program is oriented to sites rather than reactors. Therefore, calculations were made on a "per site" rather than a "per reactor" basis.

2. The resident program was initiated in 1978. Therefore, the period of time chosen for analysis of the resident inspection program was January 1978 to June 1979 (see Chart D-3).

D4. Estimates of Manhour Data for Modules

The calculations of manhour data described above were performed for all of those modules where sufficient experience had been accumulated to provide an adequate data base. However, many of the modules had been issued at or near the end of the period studied, and experience data were insufficient or nonexistent. In these cases, it was necessary to estimate the time required for module completion. Most of these estimates were made by IE; a few by the authors.

To derive the manhour-per-reactor-phase figures used in this analysis, the estimates of time required for module completion were adjusted to reflect the frequency of inspection. For example, if a module applied in the Operations phase was estimated to require 6 hr to complete and was applied twice per reactor year, the manhours-per-reactor-year figure used was 12 hr.

D5. Calculated Manhour Tables

Manhour tables summarizing the data received from IE and the results of calculations and estimates are provided in Tables D-1 through D-6. As noted above, the first six columns of these tables show the data provided by IE. The remaining information is as follows:

D5.1 Column 7 (Manhours/Reactor)

Recorded in this column is the number of manhours used per reactor phase in the Preoperational and Startup Test phases or the manhours used per reactor year in the Operations phase.

D5.2 Column 8 (No. of Times Module Applied)

The number of module applications, i.e., the number of regulatory elements and/or inspection categories, is provided in this column. For example, Module 70338B is shown in the Preoperational column of Tables C-1 and C-2 as applicable to two mitigating functions: Post Accident Heat Removal and Heat Transfer to Environment.

D5.3 Column 9 (Manhours/Module Application)

To assess the inspection manhours invested in each inspection program area, the manhours calculated for each use of a module were apportioned equally to those regulatory elements and/or inspection categories inspected by performing the module. This was done by dividing the manhours per reactor phase (or reactor year) calculated for each module (column 7) by the number of elements to which the module applied (column 8). For example, for Module 70338B in Table D-1, Column 7 indicates that the calculated manhours per reactor Preoperational Test phase for this module was 11. Column 8 shows that the module applied to two different regulatory elements or inspection categories. For the purposes of the assessment, it was assumed that 11/2, or 5.5, manhours of the inspection effort was invested in each of these two applications. This figure is shown in Column 9.

D5.4 Column 10 (Date Module Issued)

Dates shown in this column are the initial issue date of the module. Blanks in this column indicate that the module was issued on or before January 1, 1976, in the case of regional inspection modules, or on or before January 1, 1978, in the case of resident inspection modules.

D5.5 Column 11 (Remarks)

The notation "EN" in this column indicates that an estimate of manhours required to complete the module was provided by IE and served as the basis for manpower allocations. An "ES" in this column indicates that an estimate was provided by the authors.

D5.6 Column 12 PWR (1), BWR (2)

The numbers 1 and 2 in this column identify modules which are specific for PWR or BWR, respectively.

D6. Comments on Data and Calculations

The following comments pertain to the data and the calculations discussed in this appendix.

D6.1 Data Provided by the Office of Inspection and Enforcement

The data furnished were analyzed by NRC to obtain basic statistics such as range and mean for manhours, violations, infractions and deficiencies (Figure D-1). The manhours were further analyzed to show the distribution, first as a function of manhours and, second, as a function of standard deviation of the distribution. Additional statistical analysis is provided regarding the extent to which modules are completed during individual inspections.

The collection of the basic data is important. However, the extensiveness of the analysis in the manner reported seems unwarranted in terms of practical value. The main purpose of these analyses should be a concise report to IE management, pointing out important trends in the four basic parameters: manhours, violations, infractions, and deficiencies for each module.

D6.2 Calculations

Unfortunately, the statistical data reporting and processing system does not currently provide data on average manhours for completing inspections (modules). As a result, the extensive calculations described in

this appendix were required. It is important to note that these calculations do not represent a precise determination of manhours for each module. Although, in a few cases, calculated manhours may be incorrect by factors of 2 or 3, the lack of precision is not believed to impact significantly on the overall analysis. However, a change in the method of reporting could eliminate the need for the calculations and provide precise information.

D6.3 Conclusions

With minor changes to the reporting system and with reasonable additions to the computer processing, the information provided regarding manpower invested in modules could be more accurately determined and could also be updated periodically, either automatically or with a modest amount of effort.

MODULE 3703538

DOCKET	ACTUAL MAN-HRS	PERCENT COMPL	NUMBER VIOLATIONS	NUMBER INFRACTIONS	NUMBER DEFICIENCIES	MEAN MAN-HRS
NATION TOTALS	00051		000	000	000	010
MAN-HRS RANGE 003-022						
VIOLATION RANGE 00-00	VIOLATION MEANS 00.00					
INFRACTION RANGE 00-00	INFRACTION MEAN 00.00					
DEFICIENCIES RANGE 00-00	DEFICIENCIES MEAN 00.00					

MAN HOURS DEV. FROM MEAN	-5 UNDER	-4	-3	-2	- 1	0	+1	+2	+3	+4	+5 OVER
MAN-HR INTERVAL	00005	00006	00007	00008	00009	00010	00011	00012	00013	00014	00015
FREQUENCY(INSPECT)	00001	00002	00000	00000	00000	00000	00000	00000	00000	00001	00001
% COMPLETE WHEN CLOSED		0-20	21-40	41-60	61-80	81-100					
FREQUENCY(INSPECTIONS)		00000	00000	00000	00000	00004					

STANDARD DEV. FROM MEAN	-5 UNDER	-4	-3	-2	- 1	0	+1	+2	+3	+4	+5 OVER
MAN-HR INTERVAL	-00037	-00029	-00021	-00013	-00005	00010	00011	00019	00027	00035	0004
FREQUENCY(INSPECT)	00000	00000	00000	00000	00003	00000	00000	00001	00001	00000	00000

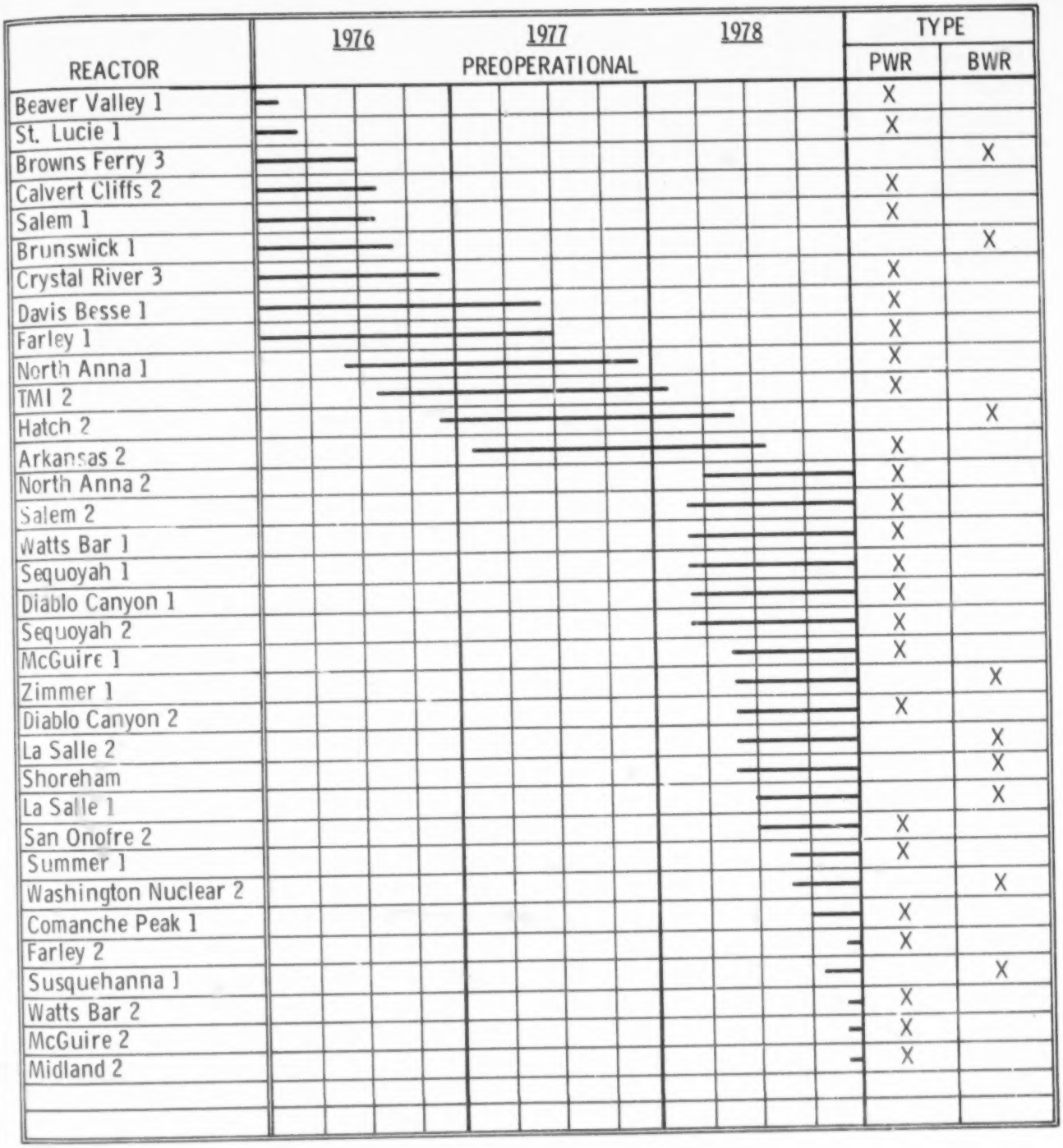
MODULE 3927068

DOCKET	ACTUAL MAN-HRS	PERCENT COMPL	NUMBER VIOLATIONS	NUMBER INFRACTIONS	NUMBER DEFICIENCIES	MEAN MAN-HRS
NATION TOTALS	01869		000	004	002	011
MAN-HRS RANGE 001-099						
VIOLATION RANGE 00-00	VIOLATION MEANS 00.00					
INFRACTION RANGE 00-01	INFRACTION MEAN 00.02					
DEFICIENCIES RANGE 00-01	DEFICIENCIES MEAN 00.01					

MAN HOURS DEV. FROM MEAN	-5 UNDER	-4	-3	-2	- 1	0	+1	+2	+3	+4	+5 OVER
MAN-HR INTERVAL	00006	00007	00008	00009	00010	00011	00012	00013	00014	00015	00016
FREQUENCY(INSPECT)	00080	00006	00007	00004	00015	00003	00008	00001	00001	00003	00036
% COMPLETE WHEN CLOSED		0-20	21-40	41-60	61-80	81-100					
FREQUENCY(INSPECTIONS)		00001	00000	00000	00000	00000					

STANDARD DEV. FROM MEAN	-5 UNDER	-4	-3	-2	- 1	0	+1	+2	+3	+4	+5 OVER
MAN-HR INTERVAL	-00078	-00061	-00044	-00027	-00010	00011	00028	00041	00058	00075	0009
FREQUENCY(INSPECT)	00000	00000	00000	00000	00112	00003	00029	00014	00004	00001	00001

Figure D-1. Direct Inspection Effort and Noncompliances for Closed Modules



REACTOR	TYPE PWR	TYPE BWR
Beaver Valley 1	X	
St. Lucie 1	X	
Browns Ferry 3		X
Calvert Cliffs 2	X	
Salem 1	X	
Brunswick 1		X
Crystal River 3	X	
Davis Besse 1	X	
Farley 1	X	
North Anna 1	X	
TMI 2	X	
Hatch 2		X
Arkansas 2	X	
North Anna 2	X	
Salem 2	X	
Watts Bar 1	X	
Sequoyah 1	X	
Diablo Canyon 1	X	
Sequoyah 2	X	
McGuire 1	X	
Zimmer 1		X
Diablo Canyon 2	X	
La Salle 2		X
Shoreham		X
La Salle 1		X
San Onofre 2	X	
Summer 1	X	
Washington Nuclear 2		X
Comanche Peak 1	X	
Farley 2	X	
Susquehanna 1		X
Watts Bar 2	X	
McGuire 2	X	
Midland 2	X	

Chart D-1. Regional Inspection Activity

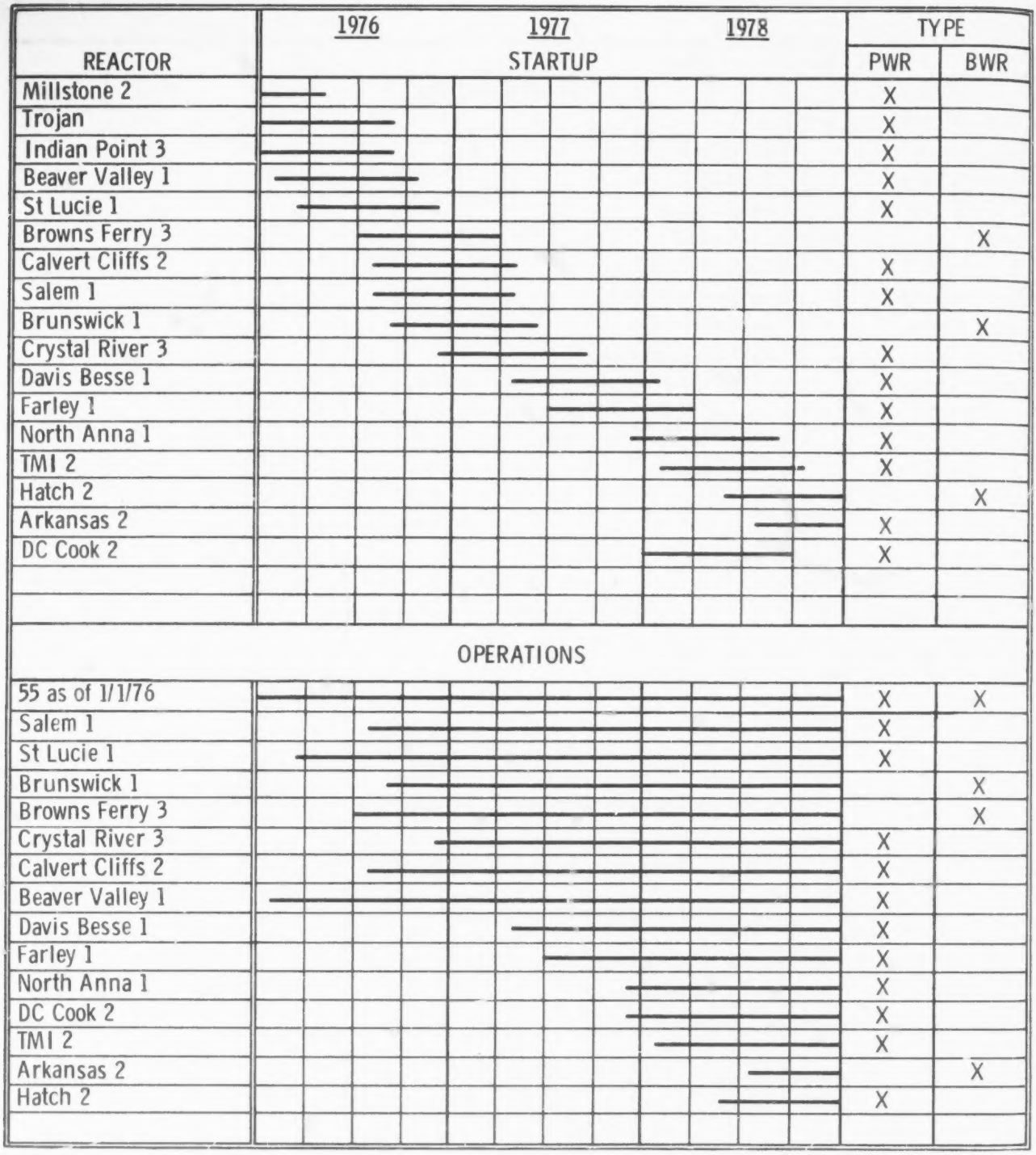


Chart D-2. Regional Inspection Activity

REACTOR	INSPECTION STARTED	1978 / 1979 PREOPERATIONAL	TYPE PWR	TYPE BWR
North Anna 2	7/16/78		X	
Salem 2	7/10/78		X	
Watts Bar 1	10/1/78		X	
Diablo Canyon 1	2/28/78		X	
Diablo Canyon 2	2/28/78		X	
San Onofre 2	10/1/78		X	
Commanche Peak 1	8/6/78		X	
Susquehanna 1	9/24/78			X
Watts Bar 2	10/1/78		X	
Midland 2	7/24/78		X	
STARTUP				
North Anna 1	7/16/78		X	
Hatch 2	12/12/78			X
Arkansas 2	10/30/78		X	
OPERATIONS				
Peach Bottom 2	3/1/79			X
Peach Bottom 3	3/1/79			X
Hatch 1	12/12/78			X
Oconee 1	12/17/78		X	
Oconee 2	12/17/78		X	
Oconee 3	12/17/78		X	
Surrey 1	12/17/78		X	
Surrey 2	12/17/78		X	
Browns Ferry 1	11/20/78			X
Browns Ferry 2	11/20/78			X
DC Cook 1	2/5/79		X	
Dresden 1	10/2/78			X
Dresden 2	10/2/78			X
Dresden 3	10/2/78			X
Praire Island 1	9/5/78		X	
Praire Island 2	9/5/78		X	
Quad Cities 1	4/16/79			X
Quad Cities 2	4/16/79			X
Zion 1	5/1/79		X	
Zion 2	5/1/79		X	
Arkansas 1	10/30/78		X	
Indian Point 1	9/27/78		X	
Indian Point 2	9/27/78		X	
Millstone 1	11/5/78		X	
Millstone 2	11/5/78			X
Trojan	3/13/78		X	
Indian Point 3	9/27/78		X	
Salem 1	7/10/78		X	
Browns Ferry 3	11/20/78			X
North Anna 1	7/16/78		X	
DC Cook 2	2/5/79		X	
Arkansas 2	10/30/78		X	
Hatch 2	12/12/78			X

Chart D-3. Resident Inspection Activity

Table D-1

Calculated Manhours Preoperational - Regional

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Phase	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
30301B	284	24	0	0	0	19	2	9.5			
30703B	1449	559	0	1	0	96	1	96.0			
35030B	0	0	0	0	0	0	1	0.0	1/77		
35301B	276	26	0	1	0	18	22	.8			
36301B	223	30	0	0	0	15	1	15.0			
39301B	75	13	0	0	0	5	2	2.5			
40301B	102	16	0	0	0	7	2	3.5			
41301B	187	22	0	0	0	12	2	6.0			
42400B	314	38	0	0	0	21	2	10.5			
42450B	554	38	0	0	0	37	2	18.5			
42451B	386	29	0	2	0	26	2	13.0			
42452B	222	21	0	0	0	15	2	7.5			
42702B	304	28	0	4	1	20	6	3.3			
60501B	188	25	0	1	2	12	2	6.0			
70300B	0	0	0	0	0	0	1	0.0			
70301B	915	60	0	0	1	61	1	61.0			
70302B	375	47	0	1	1	25	1	25.0			
70303B	197	24	0	0	0	13	1	13.0			
70304B	62	4	0	0	0	4	12	.3			
70305B	7	3	0	0	0	0	4	0.0			
70306B	6	3	0	0	0	0	5	0.0			
70307B	499	28	0	0	0	33	1	33.0			
70308B	22	1	0	0	0	2	9	.2			1
70311B	32	5	0	0	0	2	2	1.0			
70312B	15	3	0	0	0	1	1	1.0			
70313B	673	18	0	0	1	45	1	45.0			
70314B	296	12	0	1	1	26	1	26.0			1
70315B	45	3	0	0	0	3	22	.1			
70316B	19	3	0	0	0	1	10	.1			
70317B	22	3	0	0	0	1	8	.1			
70320B	57	8	0	0	0	4	1	4.0			
70322B	14	1	0	0	0	14	12	1.2	1/79		
70323B	180	18	0	0	0	12	1	12.0			
70324B	20	1	0	0	0	2	15	.1			1
70325B	47	13	0	1	0	3	3	1.0			
70326B	25	5	0	0	0	2	5	.4			
70329B	45	8	0	0	0	3	2	1.5			
70331B	45	8	0	0	0	3	1	3.0			
70332B	26	7	0	0	0	2	3	.7			
70333B	10	1	0	0	0	3	4	.8	1/79		1
70334B	0	0	0	0	0	5	1	5.0	1/79		
70335B	0	0	0	0	0	3	3	1.0	1/79		
70336B	0	0	0	0	0	6	8	.8	1/79		
70337B	203	23	0	0	0	16	3	5.3	7/76		
70338B	124	25	0	0	0	11	2	5.5			1
70339B	115	23	0	1	0	10	6	1.7			1
70340B	102	18	0	0	0	7	3	2.3			
70341B	254	29	0	0	0	17	3	5.7			
70342B	0	0	0	0	0	3	1	3.0	1/79		
70343B	65	16	0	0	0	6	5	1.2			1
70344B	102	28	0	0	0	7	1	7.0			
70345B	173	26	0	0	0	11	4	2.8			
70346B	55	19	0	0	0	5	2	2.5			1

Table D-1 (cont)

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Phase	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
70347B	0	0	0	0	0	2	1	2.0	1/79		1
70348B	0	0	0	0	0	3	4	.8	1/79		
70349B	233	19	0	0	0	20	1	20.0			1
70350B	336	19	0	0	1	22	1	22.0			
70351B	147	16	0	0	0	13	1	13.0			1
70352B	226	20	0	2	1	15	1	15.0			
70353B	161	14	0	1	0	11	1	11.0			
70354B	288	48	0	2	0	25	1	25.0			1
70355B	290	38	0	0	0	19	1	19.0			
70356B	0	0	0	0	0	3	3	1.0	1/79		2
70357B	0	0	0	0	0	4	3	1.3	1/79		2
70358B	186	28	0	0	0	52	1	52.0			2
70359B	0	0	0	0	0	4	9	.4	1/79		2
70360B	243	39	0	0	0	67	1	67.0			2
70361B	0	0	0	0	0	6	1	6.0			2
70370B	143	13	0	0	0	15	4	3.8	4/77		
70400B	0	0	0	0	0	0	1	0.0			
70431B	0	0	0	0	0	6	1	6.0	1/79		
70432B	0	0	0	0	0	6	3	2.0	1/79		
70433B	0	0	0	0	0	5	4	1.2	1/79		1
70434B	0	0	0	0	0	6	1	6.0	1/79		
70435B	0	0	0	0	0	6	3	2.0	1/79		
70436B	0	0	0	0	0	2	2	.8	1/79		
70437B	0	0	0	0	0	6	3	2.0	1/79		
70438B	0	0	0	0	0	5	2	.5	1/79		1
70439B	0	0	0	0	0	5	2	.8	1/79		1
70440B	0	0	0	0	0	6	3	2.0	1/79		
70441B	0	0	0	0	0	6	3	2.0	1/79		
70442B	0	0	0	0	0	6	1	6.0	1/79		
70443B	0	0	0	0	0	5	5	1.0	1/79		1
70444B	0	0	0	0	0	6	1	6.0	1/79		
70445B	0	0	0	0	0	6	4	1.5	1/79		
70446B	0	0	0	0	0	5	2	2.5	1/79		1
70447B	0	0	0	0	0	5	1	5.0	1/79		1
70448B	0	0	0	0	0	6	4	1.5	1/79		
70449B	0	0	0	0	0	5	1	5.0	1/79		1
70450B	0	0	0	0	0	6	1	6.0	1/79		
70451B	0	0	0	0	0	5	1	5.0	1/79		1
70452B	0	0	0	0	0	6	1	6.0	1/79		
70453B	0	0	0	0	0	6	1	6.0	1/79		
70454B	0	0	0	0	0	5	1	5.0	1/79		1
70455B	0	0	0	0	0	6	1	6.0	1/79		
70456B	0	0	0	0	0	8	3	2.7	1/79		2
70457B	0	0	0	0	0	8	3	2.7	1/79		2
70458B	0	0	0	0	0	8	1	8.0	1/79		2
70459B	0	0	0	0	0	8	6	1.3	1/79		2
70460B	0	0	0	0	0	8	1	8.0	1/79		2
70461B	0	0	0	0	0	8	1	8.0	1/79		2
70531B	0	0	0	0	0	1	1	1.0	1/79		
70532B	0	0	0	0	0	1	3	.3	1/79		
70533B	0	0	0	0	0	2	4	.5	1/79		1
70534B	0	0	0	0	0	1	1	1.0	1/79		
70535B	0	0	0	0	0	1	3	.3	1/79		

Table D-1 (cont)

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Interactions	6 No. of Deficiencies	7 Manhours/Reactor Phase	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
70536B	0	0	0	0	0	1	8	.1	1/79		
70537B	0	0	0	0	0	1	8	.3	1/79		
70538B	0	0	0	0	0	8	8	1.0	1/79		1
70539B	0	0	0	0	0	8	8	.3	1/79		1
70540B	0	0	0	0	0	1	3	.3	1/79		
70541B	0	0	0	0	0	1	3	.3	1/79		
70542B	0	0	0	0	0	1	1	1.0	1/79		
70543B	0	0	0	0	0	8	5	.4	1/79		1
70544B	0	0	0	0	0	1	1	1.0	1/79		
70545B	0	0	0	0	0	1	4	.3	1/79		
70546B	0	0	0	0	0	8	8	1.0	1/79		1
70547B	0	0	0	0	0	8	1	2.0	1/79		1
70548B	0	0	0	0	0	1	4	.3	1/79		
70549B	0	0	0	0	0	8	1	2.0	1/79		1
70550B	0	0	0	0	0	1	1	1.0	1/79		
70551B	0	0	0	0	0	8	1	2.0	1/79		1
70552B	0	0	0	0	0	1	1	1.0	1/79		
70553B	0	0	0	0	0	1	1	1.0	1/79		
70554B	0	0	0	0	0	8	1	2.0	1/79		1
70555B	0	0	0	0	0	1	1	1.0	1/79		
70556B	0	0	0	0	0	8	3	.7	1/79		
70557B	0	0	0	0	0	8	3	.7	1/79		
70558B	0	0	0	0	0	8	1	2.0	1/79		
70559B	0	0	0	0	0	8	9	.2	1/79		
70560B	0	0	0	0	0	8	1	2.0	1/79		
70561B	0	0	0	0	0	8	1	2.0	1/79		
71301B	259	14	0	0	0	19	8	9.5	4/76		
80310B	294	22	0	0	0	19	8	9.5			
80320B	346	21	0	2	2	23	1	23.0			
80330B	397	23	0	0	1	26	1	26.0			
82310B	41	18	0	0	0	3	1	3.0			
82330B	178	27	0	0	0	12	8	6.0			
82331B	372	39	0	0	0	25	8	12.5			
82332B	235	28	0	0	0	16	8	8.0			
83310B	24	15	0	0	0	2	1	2.0			
83315B	497	44	0	0	0	33	8	16.5			
83320B	308	42	0	0	0	20	8	10.0			
84310B	21	14	0	0	0	1	1	1.0			
84330B	500	76	0	0	0	33	8	16.5			
84331B	488	70	0	4	0	32	8	16.0			
84332B	227	32	0	0	0	15	8	7.5			
90711B	34	9	0	0	0	2	8	1.0			
91300B	77	23	0	0	1	5	1	5.0			
92701B	1694	376	0	4	2	112	1	112.0			
92702B	152	52	0	1	0	10	1	10.0			
92703B	183	53	0	1	4	12	1	12.0			
92704B	233	21	0	0	0	15	1	15.0			
92705B	200	16	0	2	0	13	1	13.0			
92706B	4477	444	0	7	4	296	2	148.0			
92715B	1	1	0	0	0	0	1	0.0	10/77		
92716B	4	1	0	0	0	0	1	0.0	10/77		
93700B	13	2	0	0	0	1	1	1.0			
93701B	20	8	0	1	0	1	1	1.0			
94300B	1334	83	0	2	0	88	1	88.0			

Table D-2

Calculated Manhours Startup - Regional

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Phase	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 per(1), 380(2)
30703B	500	171	0	0	0	32	1	32.0			
35030B	0	0	0	0	0	0	1	0.0	1/77		
35501B	143	28	0	0	1	9	10	0.9			
35740B	107	24	0	3	0	10	1	10.0	10/76		
35741B	121	23	0	0	2	11	2	5.5	10/76		
35742B	97	22	0	2	2	9	2	4.5	10/76		
35743B	170	22	0	0	0	16	2	8.0	10/76		
35744B	173	28	0	2	1	16	6	2.7	10/76		
35745B	90	22	0	0	0	8	6	1.3	10/76		
35746B	131	22	0	1	2	12	4	3.0	10/76		
35747B	161	24	0	4	3	15	8	1.9	10/76		
35748B	129	25	0	0	0	12	2	6.0	10/76		
35749B	89	25	0	0	0	8	2	4.0	10/76		
35750B	107	22	0	1	0	10	2	5.0	10/76		
36100B	285	68	0	3	5	18	2	9.0			
70308B	27	4	0	0	0	10	12	0.8			"
70314B	18	5	0	0	0	6	6	1.0			
70324B	44	5	0	1	0	16	17	0.9			
70325B	27	7	0	0	0	10	3	3.3			
70370B	72	3	0	1	0	10	4	2.5	4/77		
71501B	252	31	0	6	2	16	1	16.0			
72300B	0	0	0	0	0	0	2	0.0			
72301B	0	0	0	0	0	0	1	0.0			
72400B	72	19	0	0	0	5	2	2.5	4/76		
72500B	157	18	0	0	0	10	5	2.0			
72502B	48	4	0	0	0	17	2	8.5			
72504B	8	4	0	0	0	3	8	0.4			"
72506B	10	5	0	0	0	4	7	0.6			"
72508B	10	6	0	0	0	4	5	0.8			"
72510B	5	3	0	0	0	2	5	0.4			"
72512B	3	2	0	0	0	1	5	0.2			"
72514B	12	4	0	0	0	4	2	2.0			"
72516B	2	2	0	0	0	1	5	0.2			"
72518B	2	2	0	0	0	1	1	1.0			"
72520B	5	3	0	0	0	2	17	0.1			"
72524B	468	14	0	1	0	30	5	6.0			"
72526B	70	3	0	0	0	25	4	6.3			"
72528B	146	15	0	1	0	9	17	0.5			"
72530B	174	19	0	0	0	11	6	1.8			"
72531B	3	1	0	0	0	1	4	0.3			"
72532B	33	4	0	0	0	12	12	1.0			"
72536B	28	6	0	0	0	10	11	0.9			"
72540B	34	5	0	0	0	12	3	4.0			"
72544B	17	6	0	0	0	6	3	2.0			"
72548B	35	4	0	0	0	13	3	4.3			"
72551B	24	4	0	1	0	9	2	4.5			"
72554B	37	6	0	0	0	13	1	13.0			"

Table D-2 (cont)

1	2	3	4	5	6	7	8	9	10	11	12
Audit Item	Total Hours	No. of Inspectors	No. of Violations	No. of Infractions	No. of Deficiencies	Manhours/Reactor Phase	No. of Man Years Audit Duties	Manhours/Audit Application	See Audit Detail	Remarks	Phase(1), NRR(2)
72558B	30	6	0	0	0	11	3	3.7			2
72564B	85	18	0	0	0	7	4	1.8			1
72566B	31	11	0	0	0	2	2	1.0			1
72568B	71	17	0	0	0	6	4	1.5			1
72570B	86	14	0	0	0	5	3	2.3			1
72572B	67	16	0	0	0	5	3	1.7			1
72574B	32	13	0	0	0	3	3	1.0			1
72576B	29	12	0	0	0	2	2	1.0			1
72578B	52	16	0	0	0	4	1	4.0			1
72580B	46	15	0	0	0	4	1	4.0			1
72582B	63	16	0	0	0	5	5	1.0			1
72584B	36	13	0	0	0	3	2	1.5			1
72586B	62	16	0	0	0	5	12	0.4			1
72592B	607	11	0	4	2	47	8	5.9			1
72598B	192	17	0	0	4	15	8	1.9			1
72600B	109	21	0	2	0	9	8	1.1			1
72604B	113	16	0	0	1	9	9	1.0			1
72608B	67	16	0	1	0	5	3	1.7			1
72612B	81	15	0	0	0	6	2	3.0			1
72616B	65	16	0	0	1	5	1	5.0			1
72620B	81	15	0	1	0	6	2	3.0			1
72624B	84	19	0	0	1	7	3	2.3			1
72628B	117	18	0	0	0	9	3	3.0			1
83530B	209	28	0	7	1	13	1	13.0			
84530B	203	30	0	1	2	13	1	13.0			
90501B	53	11	0	1	0	3	1	3.0			
92701B	407	114	0	2	0	26	1	26.0			
92702B	69	17	0	2	0	4	1	4.0			
92703B	44	16	0	0	0	3	1	3.0			
92704B	161	16	0	0	0	10	1	10.0			
92705B	201	14	0	1	0	13	1	13.0			
92706B	1378	131	0	17	4	89	2	44.5			
93700B	87	4	0	0	0	6	1	6.0			
93701B	23	5	0	1	1	1	1	1.0			

Table D-3

Calculated Manhours Operations - Regional

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Year	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), VWR(2)
30700B	175	14	0	0	0	1	1	1.0			
30702B	1295	203	0	0	0	7	1	7.0			
30703B	8069	4454	0	1	0	43	1	43.0			
35030B	0	0	0	0	0	0	1	0.0	1/77		
35701B	1096	179	0	6	7	6	1	6.0			
35751B	0	0	0	0	0	3	2	1.5	1/79	EN	
36700B	862	193	0	5	5	5	1	5.0			
36701B	0	0	0	0	0	7	1	7.0	1/79	EN	
37700B	1853	196	0	28	17	10	2	5.0			
37701B	1103	66	0	8	0	8	2	4.0	10/76		
37702B	19	2	0	0	0	3	2	2.0	1/79	ES	
37703B	0	0	0	0	0	5	2	2.5	1/79	EN	
38701B	0	0	0	0	0	10	4	2.5	1/79	EN	
38702B	0	0	0	0	0	10	2	5.0	1/79	EN	
39701B	31	2	0	0	0	5	2	2.5	1/79	ES	
39702B	50	3	0	0	0	5	3	1.7	1/79	ES	
40700B	1943	249	0	43	36	10	2	5.0			
40701B	7	1	0	0	0	4	2	2.0	1/79	ES	
40702B	19	3	0	3	0	2	1	2.0	1/79	ES	
40703B	5	1	0	0	0	3	2	1.5	1/79	ES	
41700B	1012	170	0	10	8	5	1	5.0			
41701B	1002	166	0	28	23	5	1	5.0			
42700B	2470	188	0	20	30	13	1	13.0			
42703B	54	5	0	0	0	3	2	1.5	1/79	ES	
54701B	474	125	0	5	1	2	1	2.0	1/79		
55700B	530	88	0	8	2	3	2	1.5			
56700B	1738	183	0	33	17	9	2	4.5			
56701B	1053	170	0	7	9	6	2	3.0			
57700B	457	77	0	5	3	2	1	2.0			
60705B	916	145	0	3	2	5	2	2.5			
60710B	1730	148	0	21	19	9	2	4.5			
61700B	1989	186	0	34	16	10	2	5.0			
61701B	2493	136	0	11	6	14	1	14.0	4/76		
61702B	674	97	0	5	1	4	4	1.0	7/76		
61703B	98	29	0	2	1	2	5	.4	10/76		2
61704B	73	31	0	0	1	1	6	0.2	10/76		1
61705B	111	37	0	4	1	1	10	.1	10/76		
61706B	279	85	0	1	1	2	6	.3	10/76		
61707B	237	84	0	1	2	2	2	1.0	10/76		
61708B	115	53	0	1	0	1	2	.5	1/77		1
61709B	76	49	0	0	0	1	2	.5	1/77		1
61710B	137	58	0	1	1	2	2	1.0	1/77		1
61711B	71	32	0	1	0	1	1	1.0	1/77		1
61721B	1234	119	0	18	8	9	2	4.5	1/77		
61724B	0	0	0	0	0	3	1	3.0	1/79	EN	
61725B	0	0	0	0	0	4	2	2.0	1/79	EN	
62700B	2237	181	0	42	33	12	1	12.0			

Table D-3 (cont)

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Year	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
62701B	1253	159	0	6	1	7	2	3.5			
62702B	0	0	0	0	0	7	1	7.0	1/79	EN	
63700B	58	13	0	0	0	0	1	0.0			
71710B	8452	731	0	143	58	45	1	45.0			
71711B	572	140	0	4	0	3	11	.3			
72700B	667	137	0	8	8	4	1	4.0			
72701B	440	52	0	5	1	2	1	2.0			
73051B	586	97	0	2	0	3	1	3.0	4/76		
73052B	680	100	0	3	1	4	1	4.0	4/76		
73753B	1234	105	0	8	1	7	1	7.0	4/76		
73755B	854	110	0	4	3	5	1	5.0	4/76		
80710B	4223	212	0	76	172	22	1	22.0			
82710B	1169	175	0	14	3	6	1	6.0			
82711B	1922	187	0	66	22	10	1	10.0			
82712B	1617	246	0	11	8	9	1	9.0			
83740B	5764	296	0	166	76	30	1	30.0			
83745B	2596	97	0	75	11	14	2	7.0			
84710B	4866	251	0	154	36	26	2	13.0			
84711B	3073	271	0	26	20	16	2	8.0			
86700B	99	12	0	3	1	1	8	.1			
86712B	0	0	0	0	0	5	4	1.3	1/79	EN	
86714B	10	2	0	0	0	5	2	2.5	1/79	ES	
86716B	1	1	0	0	0	2	1	2.0	1/79	ES	
86718B	0	0	0	0	0	8	1	8.0	1/79	EN	
86720B	4	2	0	0	0	2	1	2.0	1/79	ES	
90712B	2425	462	0	4	3	17	1	17.0	10/76		
90713B	500	122	0	6	1	5	1	5.0	7/77		
90714B	13	3	0	0	0	1	1	1.0	1/79	ES	
92700B	6247	1021	3	132	37	33	2	16.5			
92701B	7218	2146	0	121	42	38	1	38.0			
92702B	4054	1262	0	48	28	21	1	21.0			
92703B	2751	878	0	13	3	14	1	14.0			
92704B	1140	157	0	5	0	6	1	6.0			
92705B	4227	243	0	33	16	22	1	22.0			
92706B	24406	3403	2	389	108	129	2	64.5			
92709B	91	30	0	0	0	0	2	0.0			
92710B	90	9	0	0	2	0	2	0.0			
92711B	58	6	0	0	0	0	1	0.0			
92712B	486	53	0	0	0	3	1	3.0			
92715B	31	8	0	0	0	0	1	0.0	10/77		
92716B	38	11	0	0	0	0	1	0.0	10/77		
93700B	1573	76	11	30	1	8	1	8.0			
93701B	426	60	1	10	2	2	1	2.0			
94701B	20	2	0	0	0	0	1	0.0			

Table D-4

Calculated Manhours Preoperational - Resident

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Phase	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
30703C	80	37	0	0	0	17	1	17.0			
35301C	32	10	0	0	0	7	8	.9			
37301C	58	7	0	0	0	13	1	13.0			
41301C	17	6	0	0	0	4	1	4.0			
42702C	44	9	0	0	0	9	3	3.0			
60501C	27	7	0	0	0	6	1	6.0			
70302C	27	8	0	1	0	6	1	5.0			
70312C	0	0	0	0	0	35	2	17.5	1/79	ES	1
70314C	349	8	0	0	0	83	1	83.0			
70370C	9	2	0	0	0	2	2	1.0			
71302C	249	45	0	0	0	54	1	54.0			
80320C	12	2	0	0	0	3	1	3.0			
82331C	4	2	0	0	0	1	1	1.0			
83315C	5	2	0	0	0	1	1	1.0			
84330C	2	1	0	0	0	0	1	0.0			
90712C	0	0	0	0	0	0	1	0.0	1/79	ES	
92700C	116	5	0	0	0	25	2	12.5			
93700C	0	0	0	0	0	0	1	0.0			
94600C	25	2	0	0	0	2	1	2.0			

Table D-5

Calculated Manhours Startup - Resident

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Phase	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
355010	27	7	0	0	0	24	1	24.0			
605020	0	0	0	0	0	15	1	15.0		EN	
703140	0	0	0	0	0	0	1	0.0			2
703700	7	3	0	0	0	6	2	3.0			
715010	184	7	0	3	1	166	1	166.0			
725210	35	4	0	0	0	45	7	6.4			1
725220	12	1	0	0	0	15	4	3.8			1
725240	0	0	0	0	0	64	2	32.0		EN	
725260	48	1	0	2	0	48	3	16.0		ES	2
725280	312	13	0	1	0	281	11	25.5			
725300	56	5	0	0	0	50	10	5.0			
725920	20	1	0	0	0	20	8	2.5		ES	1
835300	6	4	0	0	0	5	1	5.0			
845300	3	2	0	0	0	3	1	3.0			
905010	33	4	0	0	0	30	1	30.0			
907120	42	6	0	0	0	38	1	38.0			
927000	68	6	0	1	0	67	2	33.5			
937000	28	2	0	1	0	25	1	25.0			
946000	100	3	0	0	0	90	1	90.0			

Table D-6

Calculated Manhours Operations - Resident

1 Module Number	2 Total Manhours	3 No. of Inspections	4 No. of Violations	5 No. of Infractions	6 No. of Deficiencies	7 Manhours/Reactor Year	8 No. of Times Module Applies	9 Manhours/Module Application	10 Date Module Issued	11 Remarks	12 PWR(1), BWR(2)
30703C	240	104	0	0	0	27	1	27.0			
35701C	6	4	0	0	0	1	1	1.0			
36700C	6	2	0	0	0	1	1	1.0			
37700C	61	8	0	0	0	7	2	3.5			
38700C	15	5	0	0	0	6	3	2.0		ES	
40700C	22	14	0	0	0	24	1	24.0		ES	
41700C	14	4	0	0	0	16	1	16.0		ES	
41701C	13	6	0	0	0	4	1	4.0		ES	
56700C	47	26	0	0	0	18	1	18.0		ES	
56701C	11	10	0	0	0	8	1	8.0		ES	
60705C	23	7	0	0	0	3	1	3.0			
60706C	28	6	0	0	0	3	2	1.5			
60710C	51	5	0	0	0	8	1	8.0		ES	
61700C	60	20	0	0	0	10	1	10.0		ES	
61702C	29	14	0	0	0	8	4	2.0		ES	
61703C	0	0	0	0	0	21	5	4.2		EN	2
61704C	0	0	0	0	0	16	5	3.2		EN	2
61705C	0	0	0	0	0	32	5	6.4		EN	1
61706C	36	15	0	0	3	8	3	2.7		ES	
61707C	2	2	0	0	0	2	1	2.0		ES	
61708C	2	1	0	0	0	1	2	.5		ES	1
61711C	7	3	0	0	0	2	1	2.0		ES	1
61719C	14	2	0	0	0	4	1	4.0		ES	
61720C	10	2	0	0	0	7	1	7.0		ES	
61721C	22	1	0	0	0	22	1	22.0		ES	
62700C	279	70	0	1	0	144	1	144.0		ES	
71710C	1149	91	0	5	0	130	1	130.0			
71712C	79	5	0	1	0	9	2	4.5			
72700C	26	3	0	0	0	6	1	6.0		ES	
80710C	31	3	0	0	0	4	1	4.0			
82710C	19	5	0	0	0	8	1	8.0		ES	
83740C	52	18	0	0	0	6	1	6.0			
84710C	42	20	0	0	0	5	2	2.5			
90712C	148	43	0	0	0	17	1	17.0			
92700C	337	66	0	4	0	38	2	19.0			
92709C	2	2	0	0	0	0	1	0.0			
92710C	0	0	0	0	0	0	2	0.0		ES	
92711C	0	0	0	0	0	0	1	0.0		ES	
92712C	7	4	0	0	0	1	1	1.0			
93700C	45	3	0	1	0	5	1	5.0			
94600C	51	18	0	0	0	6	1	6.0			

APPENDIX E

Analysis of Manhour Investment

E1. General

The basic goal of the study was to compare the manhours invested in each important inspection element with the importance of the element to public safety. The definition of important inspection elements and the association of inspections with inspection elements are contained in Appendices B and C. The determination of manhour investment in each application of the various inspection modules is detailed in Appendix D. In this appendix, the calculation of manhours expended for each inspection element and for each inspection category are described.

E2. Manhours Expended on Regulatory Elements

Tables C-1 through C-9 show the association of inspection modules with inspection elements. To calculate the manhours expended for an inspection element, each module shown in these tables was replaced by the manhours required to apply the module, using data from column 9 of Tables D-1 through D-6. These values were then added to determine the investment in each inspection element for program definition and program implementation in each reactor phase (Preoperational Test, Startup Test, and Operations). For example, in Table C-1 the first inspection element (Reactor Trip) has four inspection modules which are applied under Preoperational Testing - Program Definition. These are modules numbered 70305B, 70317B, 70332B, and 70334B. The inspection times calculated for these module applications are 0*, 0.1, 0.4 and 5.0, respectively.

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*Indicates that less than 0.05 manhours per reactor Preoperational Test phase was credited to inspection of the reactor trip function test program definition as a result of Module 70305B. See Appendix D for explanation of manpower allocations.

The total of the figures (5.5) represents the average manhours invested in this element for inspection of program definition during the Preoperational Test phase of each reactor. Similar calculations were made for each element in Tables C-1 through C-9. The results of these calculations are shown in Tables E-1 through E-4, for the inspection elements pertinent to the regional routine inspection program. Results for regional nonroutine inspection, independent inspection, and administrative inspection activities are shown in Table E-5. Similar results for the resident inspection program are shown in Tables E-10 through E-14. These tables are in the same format as those in Appendix C.

E3. Manhours Expended by Inspection Category

The information contained in Tables E-1 through E-5 is combined and summarized in Table E-6. This table provides an overview of manhour allocations to facilitate judgments regarding the adequacy of inspection resources applied to each inspection category. As previously noted, however, it is important to remember that the adequacy of inspection is not solely a function of the amount of time expended.

An additional table (E-7) is provided to assist in judgments regarding overall program balance. This table shows the manhour allocations for each inspection category as a percentage of the total inspection effort in each phase.

E4. Overall Program Summary

Tables E-8 and E-9 in this appendix provide manhour summaries for the total IE program in the Preoperational Test, Startup Test, and Operations phases. The first column of figures provides the combined total of manhours spent in the test phases. The second column provides figures for Operations on a reactor-year basis. Both columns show total manhours and percentages of the overall test program.

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Table E-1

Manhours by Mitigating Function - Regional

P W R	PREOPERATIONAL		STARTUP		OPERATIONS*	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
LOCA						
Reactor Trip	5.8	10.4	5.7	6.0	0.1	0.4
Emergency Core Cooling Injection	1.6	5.2				1.2
Post Accident Radioactivity Removal	11.9	14.4				
Post Accident Heat Removal	22.5	19.7				
Emergency Core Cooling Recirculation	4.5	5.3				0.6
Containment Integrity	48.5	73.8				
Emergency AC-DC Power System	9.8	8.3	2.8	8.8		
TRANSIENT						
Reactor Subcriticality	1.6	5.1	6.8	6.0	0.1	0.3
Heat Transfer to Environment	6.3	5.3	2.0			
Reactor Coolant System Overpressure Protection	1.0	2.3				
Reactor Vessel Coolant Volume Control	1.8	4.0	1.1			
Other	8.2	5.6	2.8	8.8		
T O T A L	123.5	159.4	21.2	29.6	0.2	2.5

*Note that the IE inspection program for the operations phase focuses on generic plant activities such as Quality Assurance surveillance and maintenance, rather than individual plant systems. See Tables E-3 and E-4.

Table E-1 (cont)

B W R	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
LOCA						
Reactor Trip	1.8	5.8	2.8	10.1		0.9
Post Accident Radioactivity Removal	0.8	2.6				
Emergency Cooling Injection	3.7	11.6	4.6	6.1		0.9
Emergency Coolant Recirculation	1.7	5.2				0.3
Post Accident Heat Removal	2.4	2.7	1.7	0.9		
Containment Integrity	48.8	75.7	1.5	17.4		
Other	8.1	5.1	0.6	8.4		
TRANSIENT						
Reactor Subcriti-cality	2.2	7.2	5.2	10.1		0.9
Reactor Coolant Overpressure Protection	1.0	2.3	0.5	0.5		
Vessel Water Inventory	4.2	11.4	5.1	7.0		0,9
Heat Transfer to Environment	8.5	7.4	3.2	18.4		
Other	8.1	5.1	0.6	8.4		
T O T A L	91.3	142.1	25.8	87.3	0,0	3,9

Table E-2

Manhours by Initiating Event - Regional

P W R	PREOPERATIONAL		STARTUP		OPERATIONS*	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactivity Transients	1.5	4.0	37.3	49.2	0.9	8.0
RCS Pressure Transients	3.0	9.3	2.5	1.5		
Reactor/Steam Demand Mismatch	10.8	7.7	7.3	15.1	1.5	1.5
RCS Heat Removal Transients	1.3	1.0	0.4	2.1		
Loss of Coolant Accident	23.8	10.8	3.5	2.5	1.5	1.5
Core Power Distribution			9.4	25.1	1.4	2.4
Events Affecting Plant Instrumentation	82.7	37.7	16.8	18.2	0.4	0.4
Miscellaneous Initiating Events	46.3	58.0			8.8	22.1
T O T A L	169.4	128.5	77.2	113.7	14.5	35.9

*Note that the IE inspection program for the operations phase focuses on generic plant activities such as Quality Assurance surveillance and maintenance, rather than individual plant systems. See Tables E-3 and E-4.

Table E-2 (cont)

B W R	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactivity Transients	1.7	5.7	21.7	21.0	1.4	4.4
RCS Pressure Transients	1.0	2.2		0.5		
Reactor/Steam Demand Mismatch	9.9	7.8	8.4	29.2	1.5	1.5
RCS Heat Removal Transients	2.1	4.3	0.8	10.6		
Loss of Coolant Accidents	3.8	3.8	2.9	2.5	1.5	1.5
Core Power Distribution			5.0	22.7	1.3	1.8
Events Affecting Plant Instrumentation	160.2	40.1	2.5	17.9	0.4	0.8
Miscellaneous Initiating Events	51.6	40.3		1.0	8.8	22.1
T O T A L	230.3	104.2	41.3	105.4	14.9	32.1

Table E-3

Manhours for 10CFR50 Appendix B - Regional

CRITERIA	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Organization	0.8	0.8			1.5	
Quality Assurance Program	10.3	0.8	10.0		7.5	
Design Control			2.7	2.7	2.0	9.0
Procurement Document Control			3.0	3.0	2.5	2.5
Instructions Procedures Drawings	3.3	43.3			2.0	9.0
Document Control	11.3	11.3	7.2	7.2	3.7	1.7
Control of Purchased Material Equipment and Services			4.9	4.9	2.5	2.5
Identification and Control of Materials, Parts and Components			1.9	1.9		
Control of Special Processes						

Table E-3 (cont)

CRITERIA	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Inspection	0.8	0.8	2.7	2.7		
Test Control	61.8	25.8	7.4	4.9	2.5	8.5
Control of Measuring and Test Equipment	0.8	0.8	9.7	7.2	3.0	
Handling Storage and Shipping			1.9	1.9	5.0	5.0
Inspection Test and Operating Status						
Nonconforming Materials Parts or Components			1.9	1.9		
Corrective Action	0.8	0.8	0.9	0.9		
Quality Assurance Records	3.3	3.3	6.9	6.9	2.5	2.5
Audits	0.8	0.8	6.4	6.4	2.0	2.0
TOTAL	94.0	88.5	67.5	52.5	36.7	42.7

Table E-4

Manhours for Other Routine Inspections - Regional

	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Surveillance	0.8	0.8	1.3	1.3	26.5	29.5
Maintenance		13.0	8.0	8.0	10.5	15.5
Calibration			1.3	1.3	9.5	7.5
Organization and Training	10.3	25.3			15.5	23.5
Emergency Planning	29.8	37.3			1.5	29.5
Public Exposure	49.5	98.5		13.0	9.4	58.9
Occupational Exposure	26.5	26.5		13.0	7.1	37.1
10CFR21 Requirements			9.0	9.0		
Plant Status		23.5		16.0	6.0	58.3
Inspection Program Control (IE)	24.0	7.5				
TOTAL	140.9	232.4	19.6	61.6	86.0	259.8

Table E-5

Manhours for Nonroutine, Independent and Administrative Inspections - Regional

	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Non routine Inspection	1.0	253.0		66.0	18.0	153.0
Administrative	121.0		32.0		51.0	
Independent Inspection	148.0	148.0	44.5	44.5	64.5	64.5
TOTAL	270.0	401.0	76.5	110.5	133.5	217.5

Table E-6

Manhours by Inspection Category - Regional

	Manhours Per PreOP		Manhours Per Startup		Manhours Per Year Operation	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
B W R						
Mitigating Systems	91	142	26	87		4
Initiating Events	230	104	41	105	15	32
10CFR50 APP B	94	89	68	53	37	43
Other Routine Inspection	141	232	20	62	86	260
Nonroutine Inspection	1	253		66	18	153
Independent Inspection	148	148	45	45	65	65
Admin. Activities	121		32		51	
SUB TOTALS	826	968	232	418	272	557
T O T A L S	1794 Manhours/PreOP		650 Manhours/Startup		829 Manhours/Yr. of OP	
	100 Manhours/Month		72 Manhours/Month		69 Manhours/Month	
P W R						
Mitigating Systems	124	159	21	30		3
Initiating Events	169	129	77	114	15	36
10CFR50 APP B	94	89	68	53	37	43
Other Routine Inspection	141	232	20	62	86	260
Nonroutine Inspection	1	253		66	18	153
Independent Inspection	148	148	45	45	65	65
Admin. Activities	121		32		51	
SUB TOTALS	798	1010	263	370	272	560
T O T A L S	1808 Manhours/PreOP		633 Manhours/Startup		832 Manhours/Yr. of OP	
	100 Manhours/Month		70 Manhours/Month		69 Manhours/Month	

Table E-7

Percent of Manhours by Inspection Category - Regional

	Manhours Per PreOP		Manhours Per Startup		Manhours Per Year Operation	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
B W R						
Mitigating Systems	5.1	7.9	4.0	13.4		0.5
Initiating Events	12.8	5.8	6.3	16.1	1.8	3.9
10CFR50 APP B	5.2	5.0	10.5	8.2	4.5	5.2
Other Routine Inspection	7.9	12.9	3.1	9.5	10.4	31.3
Nonroutine Inspection	0.1	14.0		10.2	2.2	18.4
Independent Inspection	8.3	8.3	6.9	6.9	7.8	7.8
Admin. Activities	6.7		4.9		6.2	
TOTALS	46.1	53.9	35.7	64.3	32.9	67.1
P W R						
Mitigating Systems	6.9	8.8	3.3	4.7		0.4
Initiating Events	9.3	7.1	12.2	18.0	1.8	4.3
10CFR50 APP B	5.2	4.9	10.7	8.4	4.4	5.2
Other Routine Inspection	7.8	12.8	3.2	9.8	10.3	31.3
Nonroutine Inspection	0.1	14.0		10.4	2.2	18.4
Independent Inspection	8.2	8.2	7.1	7.1	7.8	7.8
Admin. Activities	6.7		5.1		6.1	
TOTALS	44.2	55.8	41.6	58.4	32.6	67.4

Table E-8

Regional Inspection Program Manhours/PWR

INSPECTION CATEGORY	TEST PHASES MANHOURS	OPERATIONS PHASE MANHOURS/YEAR
Routine		
Mitigating	334 (14)*	3 (0)
Initiating	489 (20)	51 (6)
Appendix B	304 (12)	80 (10)
Other	455 (19)	346 (41)
Nonroutine	320 (13)	171 (21)
Independent	386 (16)	130 (16)
Administrative	153 (6)	51 (6)
Total Program	2441 (100)	832 (100)

*Figures in parentheses represent percent of total inspection hours.

Table E-9

Regional Inspection Program Manhours/BWR

INSPECTION CATEGORY	TEST PHASES MANHOURS	OPERATIONS PHASE MANHOURS/YEAR
Routine		
Mitigating	346 (14)	4 (0)
Initiating	480 (20)	47 (6)
Appendix B	304 (12)	80 (10)
Other	455 (19)	346 (41)
Nonroutine	320 (13)	171 (21)
Independent	386 (16)	130 (16)
Administrative	153 (6)	51 (6)
Total Program	2444 (100)	829 (100)

Table E-10

Manhours by Mitigating Function - Resident

PWR	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
LOCA						
Reactor Trip			6.4			6.4
Emergency Core Cooling Injection						
Post Accident Radioactivity Removal						
Post Accident Heat Removal						
Emergency Core Cooling Recirculation						
Containment Integrity						
Emergency AC-DC Power System				10.0		
TRANSIENT						
Reactor Subcriticality			6.4			6.4
Heat Transfer to Environment						
Reactor Coolant System Overpressure Protection						
Reactor Vessel Coolant Volume Control						
Other				10.0		
TOTAL			12.8	20.0		12.8

Table E-10 (cont)

BWR	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
LOCA						
Reactor Trip						7.4
Post Accident Radioactivity Removal						
Emergency Cooling Injection						
Emergency Coolant Recirculation						
Post Accident Heat Removal						
Containment Integrity				25.5		
Other				10.0		
TRANSIENT						
Reactor Subcriticality						7.4
Reactor Coolant Overpressure Protection				25.5		
Vessel Water Inventory				76.5		
Heat Transfer to Environment				25.5		
Other				10.0		
TOTAL				173.0		14.8

Table E-11

Manhours by Initiating Event - Resident

PWR	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactivity Transients			7.5	79.0		10.3
RCS Pressure Transients				31.9		
Reactor/Steam Demand Mismatch		1.0		39.9		7.3
RCS Heat Removal Transients						
Loss of Coolant Accidents		1.0		9.4		7.3
Core Power Distribution				61.3	2.0	11.3
Events Affecting Plant Instrumentation			2.5	43.2		7.3
Miscellaneous Initiating Events		92.0		15.0	1.5	19.5
TOTAL		94.0	10.0	279.7	3.5	63.0

Table E-11 (cont)

BWR	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Reactivity Transients				89.5		10.1
RCS Pressure Transients				25.5		
Reactor/Steam Demand Mismatch		1.0		33.5		7.3
RCS Heat Removal Transients						
Loss of Coolant Accidents		1.0		3.0		7.3
Core Power Distribution				57.5	2.0	10.1
Events Affecting Plant Instrumentation				46.5		8.1
Miscellaneous Initiating Events		9.0		15.0	1.5	19.5
TOTAL		11.0		270.5	3.5	62.4

Table E-12

Manhours for 10CFR50 Appendix B - Resident

CRITERIA	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Organization		0.9				
Quality Assurance Program		0.9			1.0	
Design Control						3.5
Procurement Document Control						
Instructions Procedures Drawings		16.0				3.5
Document Control		0.9				
Control of Purchased Material Equipment and Services						2.0
Identification and Control of Materials, Parts and Components						2.0
Control of Special Processes						

Table E-12 (cont)

CRITERIA	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Inspection						
Test Control		24.4				6.0
Control of Measuring and Test Equipment		0.9				
Handling Storage and Shipping						2.0
Inspection Test and Operating Status						
Nonconforming Materials Parts or Components						
Corrective Action		0.9				
Quality Assurance Records						
Audits				24.0		
TOTAL		44.9		24.0	1.0	19.0

Table E-13

Manhours for Other Routine Inspections - Resident

	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Surveillance		0.9			2.0	45.0
Maintenance						144.0
Calibration						26.0
Organization and Training		4.9				45.0
Emergency Planning		4.0				9.0
Public Exposure		3.0		3.0		6.5
Occupational Exposure		1.0		5.0		6.0
10CFR21 Requirements						
Plant Status		51.0		166.0		134.5
Inspection Program Control (IE)		17.5				
TOTAL		85.3		174.0	2.0	416.0

Table E-14

Manhours for Nonroutine, Independent and Administrative Inspections - Resident

	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Nonroutine Inspection	12.5	12.5	33.5	126.5	19.0	41.0
Administrative	17.0	2.0	43.0	90.0	27.0	6.0
Independent Inspection						
TOTAL	29.5	14.5	76.5	216.5	46.0	47.0

Table E-15

Manhours by Inspection Category - Resident

BWR	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Mitigating Systems				173		15
Initiating Events		11		271	4	62
10CFR50 APP B		45		24	1	19
Other Routine Inspections		85		174	2	416
Non-Routine Inspection	13	13	34	127	19	41
Independent Inspection						
Admin. Activities	17	2	43	90	27	6
SUB-TOTALS	30	156	77	859	53	559
TOTALS	186 Manhours/Preop 10 Manhours/Month		936 Manhours/STARTUP 104 Manhours/Month		612 Manhours/YR of OP 51 Manhours/Month	

PWR						
Mitigating Systems			13	20		13
Initiating Events			10	280	4	63
10CFR50 APP B		45		24	1	19
Other Routine Inspections		85		174	2	416
Non-Routine Inspection	13	13	34	127	19	41
Independent Inspection						
Admin. Activities	17	2	43	90	27	6
SUB-TOTALS	30	239	100	715	53	558
TOTALS	269 Manhours/Preop 15 Manhours/Month		815 Manhours/STARTUP 91 Manhours/Month		611 Manhours/YR of OP 51 Manhours/Month	

Table E-16

Percent of Manhours by Inspection Category - Resident

BWR	PREOPERATIONAL		STARTUP		OPERATIONS	
	Definition	Implementation	Definition	Implementation	Definition	Implementation
Mitigating Systems				18.5		2.5
Initiating Events		5.9		28.9	0.7	10.1
10CFR50 APP B		24.2		2.6	0.2	3.1
Other Routine Inspections		45.7		18.6	0.3	67.9
Non-Routine Inspection	7.0	7.0	3.6	13.6	3.1	6.7
Independent Inspection						
Admin. Activities	9.1	1.1	4.6	9.6	4.4	1.0
TOTALS	16.1	83.9	8.2	91.8	8.7	91.3
PWR						
Mitigating Systems			1.6	2.5		2.1
Initiating Events		35.0	1.2	34.4	0.7	10.3
10CFR50 APP B		16.7		2.9	0.2	3.1
Other Routine Inspections		31.6		21.3	0.3	68.1
Non-Routine Inspection	4.8	4.8	4.2	15.6	3.1	6.7
Independent Inspection						
Admin. Activities	6.4	0.7	5.3	11.0	4.4	1.0
TOTALS	11.2	88.8	12.3	87.7	8.7	91.3

APPENDIX F

Analysis of Noncompliance Data

F1. General

Effective inspections should reveal both the number of problems and their degree of seriousness. If an inspection is found to detect a large number of significant problems, the level of inspection effort should be sustained or increased, and the underlying causes of the problems should be identified. In the case of the reactor inspection program, this might entail increased examination of the licensee's administrative program.

F2. Manhours per Noncompliance Detected for Modules

To address the detection rate of inspections, the available experience data for the inspection modules were reviewed. For each module, the total manhours charged during the period studied were divided by the number of noncompliances detected. The results of these calculations provide an indication of the average number of manhours invested per noncompliance detected for each module. Tables F-1, F-2, and F-3 list the regional inspection modules for each phase (Preoperational Test, Startup Test, and Operations) in order of the average manhours expended to detect one noncompliance. Tables F-4, F-5, and F-6 show similar information for the resident inspection modules. Modules with high or low average manhours per noncompliance were of particular interest.

F3. Module Review

Modules with high average manhours per noncompliance were reexamined to determine whether the required inspection activities were sufficent to detect existing problems. Modules with low average manhours per noncompliance were restudied to determine whether they contained inspection activities, peculiar to these modules, which were particularly effective in detecting noncompliance. With minor exceptions, both of these types of

module review produced negative results. That is, the modules were not found to be significantly different in content.

For some modules, a high average of manhours per noncompliance may be due to factors other than the adequacy of inspection or the state of the subject being inspected. For example, some inspections in the Preoperational Test phase deal with regulatory requirements which do not apply until the Operations phase. The timing of such inspections is dictated by the need to assure that operations will be conducted safely before fuel is loaded in the reactor. It appears that, to some extent, required enforcement actions arising from these inspections may take other forms than the citation of noncompliance.

F4. Manhours per Noncompliance Detected for Program Areas

Tables F-7 and F-8 show the average manhours per noncompliance detected for inspection categories and phases, based on regional inspection modules. The rates shown represent the total manhours charged in each category divided by the total number of noncompliances reported. Several observations were made with respect to these tables:

- The average manhours per noncompliance for the Operations phase is about half of that for the Startup Test phase and nearly eight times lower than the Preoperational Test phase.
- No violations were reported during this period as a result of Preoperational Test or Startup Test phase inspections; seventeen were reported as a result of Operations phase inspections.
- Average manhours per noncompliance are very high in the administrative category. This is to be expected since the effort in this area is directed primarily to necessary activities other than inspection.
- For the period studied no specific inspection category (other than administrative) has a consistently high or low average for all three phases.

An analysis of the resident inspection program similar to that for the regional in Tables F-7 and F-8 is not presented because the available information was not sufficient to provide confidence in the average manhours per noncompliance for individual inspection categories. However, the overall average for resident inspection modules, based on 3458 inspection hours and 21 noncompliances, is 165 manhours per noncompliance. This is nearly three times as high as the overall average for regional inspection modules.

F5. Comments on Noncompliance Data

Where sufficient data were available, inspection modules and program areas with high average manhours per noncompliance were considered to be candidates for reduction in inspection effort. Similarly, inspection modules and program areas with low average manhours per noncompliance were considered to be candidates for increase in inspection effort. Final conclusions regarding potential changes in inspection effort are detailed in Section 3 of this report.

Table F-1

Manhours per Noncompliance, Preoperational - Regional

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
93701B	20	0	1	0	20.0
92703B	183	0	1	4	36.6
70325B	47	0	1	0	47.0
42702B	304	0	4	1	60.8
60501B	188	0	1	2	62.7
70352B	226	0	2	1	75.3
91300B	77	0	0	1	77.0
80320B	346	0	2	2	86.5
92705B	200	0	2	0	100.0
70339B	115	0	1	0	115.0
84331B	488	0	4	0	122.0
70354B	288	0	2	0	144.0
70314B	296	0	1	1	148.0
92702B	152	0	1	0	152.0
70353B	161	0	1	0	161.0
70302B	375	0	1	1	187.5
42451B	386	0	2	0	193.0
35301B	276	0	1	0	276.0
92701B	1694	0	4	2	282.3
70350B	336	0	0	1	336.0
80330B	397	0	0	1	397.0
92706B	4477	0	7	4	407.0
94300B	1334	0	2	0	667.0
70313B	673	0	0	1	673.0
70301B	915	0	0	1	915.0
30703B	1449	0	1	0	1449.0
70358B	186	0	0	0	9999.9*
70329B	45	0	0	0	9999.9
82310B	41	0	0	0	9999.9
70306B	6	0	0	0	9999.9
70457B	0	0	0	0	9999.9
70342B	0	0	0	0	9999.9
84332B	227	0	0	0	9999.9
42400B	314	0	0	0	9999.9
70441B	0	0	0	0	9999.9
70334B	0	0	0	0	9999.9
70558B	0	0	0	0	9999.9
70316B	19	0	0	0	9999.9
70542B	0	0	0	0	9999.9
70356B	0	0	0	0	9999.9
92704B	233	0	0	0	9999.9
36301B	223	0	0	0	9999.9
70433B	0	0	0	0	9999.9
70323B	180	0	0	0	9999.9
83310B	24	0	0	0	9999.9
70304B	62	0	0	0	9999.9
70534B	0	0	0	0	9999.9
70346B	55	0	0	0	9999.9
84330B	500	0	0	0	9999.9

*The figure 9999.9 indicates that the manhours per noncompliance were indeterminate.

Table F-1 (cont)

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
70300B	0	0	0	0	9999.9
70449B	0	0	0	0	9999.9
70340B	102	0	0	0	9999.9
71301B	259	0	0	0	9999.9
70315B	45	0	0	0	9999.9
70550B	0	0	0	0	9999.9
70351B	147	0	0	0	9999.9
92716B	4	0	0	0	9999.9
35030B	0	0	0	0	9999.9
70370B	143	0	0	0	9999.9
70332B	26	0	0	0	9999.9
82331B	372	0	0	0	9999.9
70308B	22	0	0	0	9999.9
70461B	0	0	0	0	9999.9
70344B	102	0	0	0	9999.9
90711B	34	0	0	0	9999.9
42452B	222	0	0	0	9999.9
70445B	0	0	0	0	9999.9
70336B	0	0	0	0	9999.9
70560B	0	0	0	0	9999.9
70320B	57	0	0	0	9999.9
70546B	0	0	0	0	9999.9
70355B	290	0	0	0	9999.9
92715B	1	0	0	0	9999.9
40301B	102	0	0	0	9999.9
70437B	0	0	0	0	9999.9
70326B	25	0	0	0	9999.9
83320B	308	0	0	0	9999.9
70303B	197	0	0	0	9999.9
70538B	0	0	0	0	9999.9
70348B	0	0	0	0	9999.9
93700B	13	0	0	0	9999.9
42450B	554	0	0	0	9999.9
70453B	0	0	0	0	9999.9
70338B	124	0	0	0	9999.9
80310B	294	0	0	0	9999.9
70312B	15	0	0	0	9999.9
70554B	0	0	0	0	9999.9
70357B	0	0	0	0	9999.9
82330B	178	0	0	0	9999.9
30301B	284	0	0	0	9999.9
70360B	243	0	0	0	9999.9
70331B	45	0	0	0	9999.9
70559B	0	0	0	0	9999.9
70307B	499	0	0	0	9999.9
70459B	0	0	0	0	9999.9
70343B	65	0	0	0	9999.9
83315B	497	0	0	0	9999.9
39301B	75	0	0	0	9999.9
70443B	0	0	0	0	9999.9
70335B	0	0	0	0	9999.9
70561B	0	0	0	0	9999.9
70317B	22	0	0	0	9999.9
70544B	0	0	0	0	9999.9
70347B	0	0	0	0	9999.9

Table F-1 (cont)

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
82332B	235	0	0	0	9999.9
41301B	187	0	0	0	9999.9
70435B	0	0	0	0	9999.9
70324B	20	0	0	0	9999.9
84310B	21	0	0	0	9999.9
70305B	7	0	0	0	9999.9
70536B	0	0	0	0	9999.9
70345B	173	0	0	0	9999.9
70451B	0	0	0	0	9999.9
70322B	14	0	0	0	9999.9
70552B	0	0	0	0	9999.9
70341B	254	0	0	0	9999.9
70431B	0	0	0	0	9999.9
70311B	32	0	0	0	9999.9
70532B	0	0	0	0	9999.9
70349B	233	0	0	0	9999.9
70447B	0	0	0	0	9999.9
70333B	10	0	0	0	9999.9
70548B	0	0	0	0	9999.9
70337B	203	0	0	0	9999.9
70439B	0	0	0	0	9999.9
70540B	0	0	0	0	9999.9
70455B	0	0	0	0	9999.9
70556B	0	0	0	0	9999.9
70359B	0	0	0	0	9999.9
70458B	0	0	0	0	9999.9
70442B	0	0	0	0	9999.9
70543B	0	0	0	0	9999.9
70434B	0	0	0	0	9999.9
70535B	0	0	0	0	9999.9
70450B	0	0	0	0	9999.9
70551B	0	0	0	0	9999.9
70400B	0	0	0	0	9999.9
70531B	0	0	0	0	9999.9
70446B	0	0	0	0	9999.9
70547B	0	0	0	0	9999.9
70438B	0	0	0	0	9999.9
70539B	0	0	0	0	9999.9
70454B	0	0	0	0	9999.9
70555B	0	0	0	0	9999.9
70361B	0	0	0	0	9999.9
70460B	0	0	0	0	9999.9
70444B	0	0	0	0	9999.9
70545B	0	0	0	0	9999.9
70436B	0	0	0	0	9999.9
70537B	0	0	0	0	9999.9
70452B	0	0	0	0	9999.9
70553B	0	0	0	0	9999.9
70432B	0	0	0	0	9999.9
70533B	0	0	0	0	9999.9
70448B	0	0	0	0	9999.9
70549B	0	0	0	0	9999.9
70440B	0	0	0	0	9999.9
70541B	0	0	0	0	9999.9
70456B	0	0	0	0	9999.9
70557B	0	0	0	0	9999.9

Table F-2

Manhours per Noncompliance, Startup - Regional

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
93701B	23	0	1	1	11.5
35747B	161	0	4	3	23.0
72551B	24	0	1	0	24.0
35742B	97	0	2	2	24.3
83530B	209	0	7	1	26.1
71501B	252	0	6	2	31.5
92702B	69	0	2	0	34.5
36100B	285	0	3	5	35.6
35740B	107	0	3	0	35.7
35746B	131	0	1	2	43.7
70324B	44	0	1	0	44.0
72598B	192	0	0	4	48.0
90501B	53	0	1	0	53.0
72600B	109	0	2	0	54.5
35744B	173	0	2	1	57.7
35741B	121	0	0	2	60.5
72616B	65	0	0	1	65.0
92706B	1378	0	17	4	65.6
84530B	203	0	1	2	67.7
72608B	67	0	1	0	67.0
70370B	72	0	1	0	72.0
72620B	81	0	1	0	81.0
72624B	84	0	0	1	84.0
72592B	607	0	4	2	101.2
35750B	107	0	1	0	107.0
72604B	113	0	0	1	113.0
35501B	143	0	0	1	143.0
72528B	146	0	1	0	146.0
92705B	201	0	1	0	201.0
92701B	407	0	2	0	203.5
72524B	468	0	1	0	468.0
72612B	81	0	0	0	9999.9
72500B	157	0	0	0	9999.9
93700B	87	0	0	0	9999.9
72564B	85	0	0	0	9999.9
72628B	117	0	0	0	9999.9
35748B	129	0	0	0	9999.9
92703B	44	0	0	0	9999.9
72532B	33	0	0	0	9999.9
92704B	161	0	0	0	9999.9
72301B	0	0	0	0	9999.9
72580B	46	0	0	0	9999.9
35743B	170	0	0	0	9999.9
72530B	174	0	0	0	9999.9
72508B	10	0	0	0	9999.9
72572B	67	0	0	0	9999.9
70308B	27	0	0	0	9999.9
72554B	37	0	0	0	9999.9
70314B	18	0	0	0	9999.9
72584B	36	0	0	0	9999.9
30703B	500	0	0	0	9999.9

Table F-2 (cont)

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
72516B	2	0	0	0	9999.9
72504B	8	0	0	0	9999.9
72568B	71	0	0	0	9999.9
35745B	90	0	0	0	9999.9
72540B	34	0	0	0	9999.9
72300B	0	0	0	0	9999.9
72582B	63	0	0	0	9999.9
35030B	0	0	0	0	9999.9
72526B	70	0	0	0	9999.9
72512B	3	0	0	0	9999.9
72576B	29	0	0	0	9999.9
35749B	89	0	0	0	9999.9
72548B	35	0	0	0	9999.9
70325B	27	0	0	0	9999.9
72586B	62	0	0	0	9999.9
72502B	48	0	0	0	9999.9
72520B	5	0	0	0	9999.9
72400B	72	0	0	0	9999.9
72566B	31	0	0	0	9999.9
72510B	5	0	0	0	9999.9
72536B	28	0	0	0	9999.9
72506B	10	0	0	0	9999.9
72574B	32	0	0	0	9999.9
72514B	12	0	0	0	9999.9
72531B	3	0	0	0	9999.9
72570B	86	0	0	0	9999.9
72558B	30	0	0	0	9999.9
72578B	52	0	0	0	9999.9
72518B	2	0	0	0	9999.9
72544B	17	0	0	0	9999.9

Table F-3

Manhours per Noncompliance, Operations - Regional

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
40702B	19	0	3	0	6.3
80710B	4223	0	76	172	17.0
41701B	1002	0	28	23	19.6
82711B	1922	0	66	22	21.8
61705B	111	0	4	1	22.2
83740B	5764	0	166	76	23.8
86700B	99	0	3	1	24.8
40700B	1943	0	43	36	24.6
84710B	4866	0	154	36	25.6
62700B	2237	0	42	33	29.8
83745B	2596	0	75	11	30.2
93701B	426	1	10	2	32.8
61703B	98	0	2	1	32.7
56700B	1738	0	33	17	34.8
92700B	6247	3	132	37	36.3
93700B	1573	11	30	1	37.5
61700B	1989	0	34	16	39.8
72700B	667	0	8	8	41.7
37700B	1853	0	28	17	41.2
71710B	8452	0	143	58	42.0
60710B	1730	0	21	19	43.3
92701B	7218	0	121	42	44.3
92710B	90	0	0	2	45.0
61721B	1234	0	18	8	47.5
92706B	24406	2	389	108	48.9
42700B	2470	0	20	30	49.4
92702B	4054	0	48	28	53.3
55700B	530	0	8	2	53.0
41700B	1012	0	10	8	56.2
57700B	457	0	5	3	57.1
56701B	1053	0	7	9	65.8
84711B	3073	0	26	20	66.8
82710B	1169	0	14	3	68.8
61710B	137	0	1	1	68.5
90713B	500	0	6	1	71.4
61711B	71	0	1	0	71.0
72701B	440	0	5	1	73.3
61704B	73	0	0	1	73.0
54701B	474	0	5	1	79.0
61707B	237	0	1	2	79.0
35701B	1096	0	6	7	84.3
82712B	1617	0	11	8	85.1
92705B	4227	0	33	16	86.3
36700B	862	0	5	5	86.2
61702B	674	0	5	1	112.3
61708B	115	0	1	0	115.0
73755B	854	0	4	3	122.0
37701B	1103	0	8	0	137.9
73753B	1234	0	8	1	137.1
61706B	279	0	1	1	139.5
71711B	572	0	4	0	143.0

Table F-3 (cont)

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
61701B	2493	0	11	6	146.6
73052B	680	0	3	1	170.0
92703B	2751	0	13	3	171.9
62701B	1253	0	6	1	179.0
60705B	916	0	3	2	183.2
92704B	1140	0	5	0	228.0
73051B	586	0	2	0	293.0
90712B	2425	0	4	3	346.4
30703B	8069	0	1	0	8069.0
94701B	20	0	0	0	9999.9
61709B	76	0	0	0	9999.9
86714B	10	0	0	0	9999.9
40703B	5	0	0	0	9999.9
92711B	58	0	0	0	9999.9
62702B	0	0	0	0	9999.9
90714B	13	0	0	0	9999.9
38701B	0	0	0	0	9999.9
92709B	91	0	0	0	9999.9
61724B	0	0	0	0	9999.9
86712B	0	0	0	0	9999.9
42703B	54	0	0	0	9999.9
92715B	31	0	0	0	9999.9
63700B	58	0	0	0	9999.9
86718B	0	0	0	0	9999.9
35751B	0	0	0	0	9999.9
92712B	486	0	0	0	9999.9
61725B	0	0	0	0	9999.9
86716B	1	0	0	0	9999.9
40701B	7	0	0	0	9999.9
92716B	38	0	0	0	9999.9
37702B	19	0	0	0	9999.9
86720B	4	0	0	0	9999.9
30700B	175	0	0	0	9999.9
39701B	31	0	0	0	9999.9
36701B	0	0	0	0	9999.9
37703B	0	0	0	0	9999.9
35030B	0	0	0	0	9999.9
38702B	0	0	0	0	9999.9
30702B	1295	0	0	0	9999.9
39702B	50	0	0	0	9999.9

Table F-4

Manhours per Noncompliance, Preoperational - Resident

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
70302C	27	0	1	0	27.0
92700C	116	0	0	0	9999.9
70314C	349	0	0	0	9999.9
94600C	25	0	0	0	9999.9
30703C	80	0	0	0	9999.9
93700C	0	0	0	0	9999.9
82331C	4	0	0	0	9999.9
42702C	44	0	0	0	9999.9
71302C	249	0	0	0	9999.9
37301C	58	0	0	0	9999.9
84330C	2	0	0	0	9999.9
70312C	0	0	0	0	9999.9
70370C	9	0	0	0	9999.9
35301C	32	0	0	0	9999.9
83315C	5	0	0	0	9999.9
60501C	27	0	0	0	9999.9
80320C	12	0	0	0	9999.9
41301C	17	0	0	0	9999.9
90712C	0	0	0	0	9999.9

Table F-5

Manhours Noncompliance, Startup - Resident

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
72526C	48	0	2	0	24.0
93700C	28	0	1	0	28.0
71501C	184	0	3	1	46.0
92700C	68	0	1	0	68.0
72528C	312	0	1	0	312.0
94600C	100	0	0	0	9999.9
30703C	48	0	0	0	9999.9
90712C	42	0	0	0	9999.9
72592C	20	0	0	0	9999.9
72521C	35	0	0	0	9999.9
72524C	0	0	0	0	9999.9
60502C	0	0	0	0	9999.9
84530C	3	0	0	0	9999.9
70370C	7	0	0	0	9999.9
72530C	56	0	0	0	9999.9
35501C	27	0	0	0	9999.9
83530C	6	0	0	0	9999.9
72522C	12	0	0	0	9999.9
90501C	33	0	0	0	9999.9
70314C	0	0	0	0	9999.9

Table F-6

Manhours per Noncompliance, Operations - Resident

MODULE NUMBER	TOTAL MANHOURS	NUMBER VIOLAT	NUMBER INFRAC	NUMBER DEFIC	MANHOURS/ NONCOMPLIANCE
617060	36	0	0	3	12.0
937000	45	0	1	0	45.0
717120	79	0	1	0	79.0
927000	337	0	4	0	84.3
717100	1149	0	5	0	229.8
627000	279	0	1	0	279.0
946000	51	0	0	0	9999.9
307030	240	0	0	0	9999.9
927100	0	0	0	0	9999.9
617080	2	0	0	0	9999.9
847100	42	0	0	0	9999.9
567000	47	0	0	0	9999.9
927120	7	0	0	0	9999.9
727000	26	0	0	0	9999.9
927090	2	0	0	0	9999.9
387000	15	0	0	0	9999.9
927110	0	0	0	0	9999.9
617040	0	0	0	0	9999.9
907120	148	0	0	0	9999.9
607100	51	0	0	0	9999.9
617210	22	0	0	0	9999.9
367000	6	0	0	0	9999.9
617190	14	0	0	0	9999.9
607050	23	0	0	0	9999.9
827100	19	0	0	0	9999.9
417000	14	0	0	0	9999.9
617070	2	0	0	0	9999.9
617020	29	0	0	0	9999.9
807100	31	0	0	0	9999.9
357010	6	0	0	0	9999.9
617110	7	0	0	0	9999.9
567010	11	0	0	0	9999.9
837400	52	0	0	0	9999.9
407000	22	0	0	0	9999.9
617050	0	0	0	0	9999.9
617000	60	0	0	0	9999.9
617200	10	0	0	0	9999.9
377000	61	0	0	0	9999.9
607060	28	0	0	0	9999.9
417010	13	0	0	0	9999.9
617030	0	0	0	0	9999.9

Table F-7

Manhours per Noncompliance by Inspection Category - Regional

PREOPERATIONAL

INSPECTION CATEGORIES	NONCOMPLIANCE Violations	Infractions	Deficiencies	Total	TOTAL MANHOURS	MANHOURS/ NONCOMPLIANCE
Mitigating Systems & Initiating Events	0	11	7	18	5753	320
10CFR50 Appendix B	0	4	2	6	2657	443
Other Routine	0	8	4	12	5711	476
Non Routine	0	11	6	17	3868	228
Independent	0	7	4	11	4477	407
Administrative	0	1	0	1	1831	1831
TOTAL	0	42	23	65	24,297	374

STARTUP

Mitigating Systems & Initiating Events	0	13	9	22	3725	124
10CFR50 Appendix B	0	13	11	24	1375	57
Other Routine	0	20	11	31	1164	38
Non Routine	0	7	1	8	1045	131
Independent	0	17	4	21	1378	66
Administrative	0	0	0	0	500	∞
TOTAL	0	70	36	106	9187	87

OPERATIONS

Mitigating Systems & Initiating Events	0	41	29	70	5093	73
10CFR50 Appendix B	0	55	33	88	5317	60
Other Routine	0	1019	607	1626	60,122	37
Non Routine	15	415	138	568	31,637	56
Independent	2	389	108	499	24,406	49
Administrative	0	1	0	1	9539	9539
TOTAL	17	1920	915	2852	136,114	48

Table F-8

Manhours per Noncompliance by Inspection Phase - Regional

SUMMARY

INSPECTION PHASE	NONCOMPLIANCE				TOTAL MANHOURS	MANHOURS/ NONCOMPLIANCE
	Violations	Infractions	Deficiencies	Total		
Preoperational	0	42	23	65	24,297	374
Startup	0	70	36	106	9,187	87
Operations	17	1920	915	2852	136,114	48
TOTAL	17	2032	974	3023	169,598	56

References

[1]U.S. Nuclear Regulatory Commission, "Development of A Checklist for Evaluating Maintenance, Test and Calibration Procedures Used in Nuclear Power Plants," USNRC Report NUREG/CR-1368, to be published.

[2]U.S. Nuclear Regulatory Commission Office of Inspection and Enforcement, "Inspection and Enforcement Manual," Chpts 2513 to 9500.

[3]U.S. Nuclear Regulatory Commission, "Independent Verification Options for Inspecting Nuclear Power Plant Facilities," USNRC Report NUREG/CR-0826, September 1979.

[4]U.S. Nuclear Regulatory Commission, "Reactor Safety Study, an Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," Report WASH 1400, October 1975.

[5]U.S. Nuclear Regulatory Commission, "Anticipated Transients Without SCRAM for Light Water Reactors," Report NUREG-0460, April 1978.

[6]American National Standards Institute, Inc., "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants, N18.2-1973.

[7]W. B. Cottrell, "Operating U.S. Power Reactors," Nuclear Safety 20(4):493-499 (July-August 1979).

[8]"World List of Nuclear Power Plants," Nuclear News, Vol. 22, No. 10, August 1979, pp81-86.

[9]Nucleonics Week, Vol. 20, No. 29, July 19, 1979, p 7.

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The inspection modules in the NRC inspection program for the Preoperational Test, Startup Test, and Operation phases of nuclear power plants were examined to assess whether manhours invested in each inspection were commensurate with the potential of these inspections for detecting conditions which would contribute significantly to risk. No basis was found in this assessment for fundamental changes to the inspection program. However, to improve program effectiveness, some modifications to specific parts of the program appear to be warranted.

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